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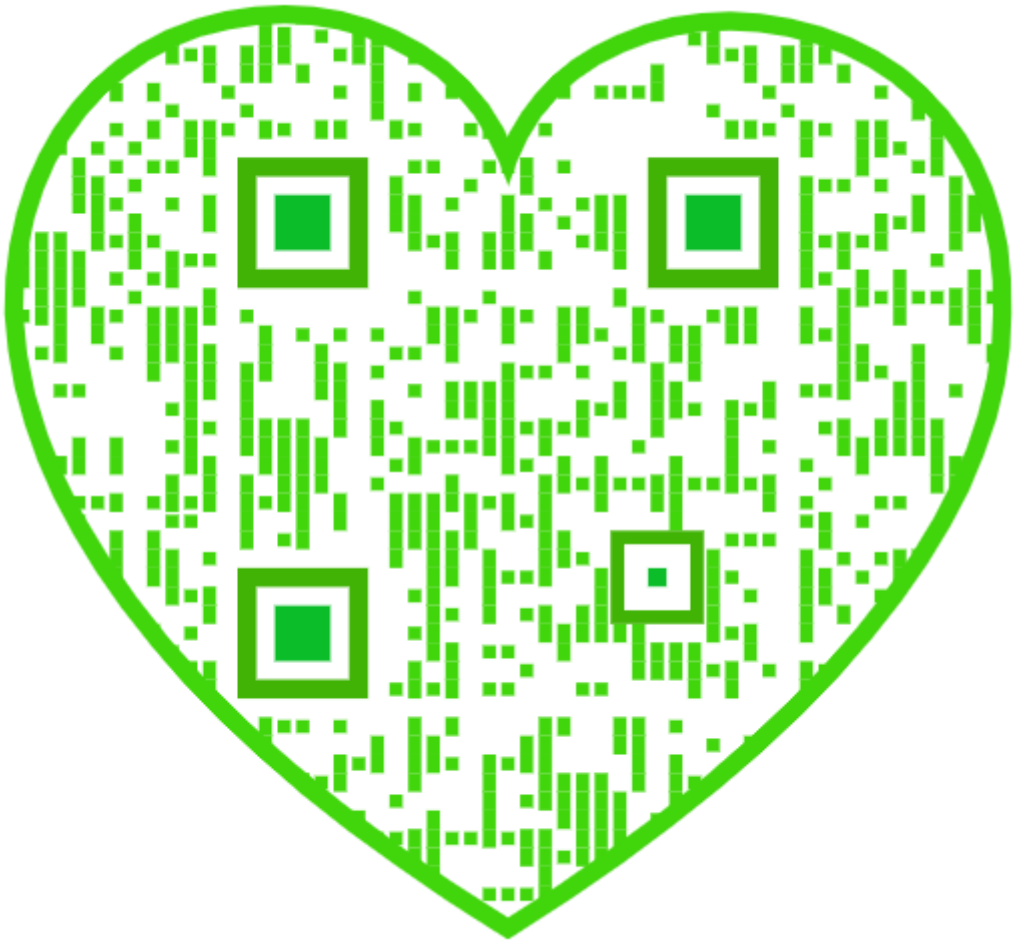
Irrigation Fruit Growing

A Western Book
for Western Planters

Compiled by O. D. Shields Loveland, Colo.



A Western Book for Western Planters

PRACTICAL INSTRUCTION FOR PROPAGATING, PLANTING, GROWING AND CARING FOR FRUIT, SHADE AND ORNAMENTAL TREES AND SMALL FRUITS ADAPTED TO THE WEST.

Compiled by O. D. Shields, Loveland, Colorado

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INTRODUCTORY

THE INTENTION of the writer of this edition is to place in the hands of Farmers and Fruit Growers a volume covering the ground so fully and plainly that any person can from its pages get the information necessary to successfully grow an orcharwd.

Twenty-five years' continuous and active work as a nurseryman in the so-called arid regions of irrigated lands, together with the help of the best experts along the different topics, fits the volume to become the authority of persons not acquainted with existing conditions. And the various pitfalls and failures of the inexperienced man may be overcome by reading and carefully following out its prescribed methods and rules.

New conditions, requiring new treatments, are always arising. And it is the writer's intention to issue supplements, each time that occasions may require, so as to keep the small grower of fruit fully posted. The same will apply to new varieties as they appear, and are tested, so that an intelligent treatise may be written of them.

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GENERAL SUGGESTIONS

LANDS ADAPTED TO FRUIT GROWING AND HOW TO PREPARE THEM.

LANDS which are naturally drained are most desirable, because they are warm and allow early cultivation. If natural drainage does not exist, then tile and other methods of drainage must be used.

Drainage not only carries off the surplus of water, but loosens the subsoil, thereby causing it to retain moisture better in time of drouth. An orchard cannot be successfully grown upon lands not well drained.

As to quality of soils: Good, deep soils are to be preferred, but others can be made to grow an orchard successfully. Mistakes are often made in locating an orchard, by giving all attention to appearances of surroundings, regardless of conditions as to soil and drainage. Or to be more explicit, a man will often locate his orchard, from which he expects to derive his fruit for home consumption, with no thought of anything excepting the improvement of the landscape surrounding his buildings. This is landscape gardening, not fruit growing.

If the soil need manuring, so far as the trees are concerned, surface manuring, after the trees are planted, is preferable. Young trees are injured by the roots coming in contact with lumps of manure.

The ideal fruit land is a loam coarse enough to be easily cultivated, and fine enough to prevent the too free access of air, and too rapid descent of water.

PREPARATION OF SOIL.

In examining fruit trees and fruits, marked differences in the same varieties are noted. In some cases trees are small and

fruit small and poorly flavored. In others, trees large, fruit large and excellent.

The grower of the first kind named thinks, usually, he has been humbugged by nurserymen. The grower of the second exhibits his fruit and secures awards.

In the First Case: Poor soil, poor cultivation, hard ground, allowing weeds to grow, necessarily produces small, feeble trees and small, poor-flavored fruit.

In the Second Case: Good cultivation and thinning of crop must produce large, fine-flavored fruit.

Land intended for an orchard must be secure from danger of being flooded in wet seasons and becoming water-soaked beneath the surface. Plow the surface to a depth of seven or eight inches and follow with a subsoiler which loosens to an additional depth of seven or eight inches. (Or dig large holes, three times the size necessary to set trees; for ordinary trees eighteen to twenty-four inches in depth and thirty to thirty-six inches in diameter, and set trees in the loose earth used to fill the hole to proper size for tree; plant four to six inches deeper than they grew in nursery; and by the time the roots have grown to the extremities of the hole so made, they will have strength to push their way into the harder surrounding earth.) To work manure to that depth it must first be spread on the surface evenly, after the whole has been subsoiled: then harrow to break it fine, and mix with top soil, and then turned under by a thorough trench plowing. This should be done in the fall, and again plowed in the spring, and your land is ready for its trees.

LAYING OUT GROUNDS.

Procure a quantity of wooden pins. Take heavy cord, long enough to reach across land to be planted, and measure distance upon it that trees are to be spaced, and with needle pass through cord a red yarn and tie at each point a tree is to be set. Then stretch along one side of the field the distance from fence that

first row is to be planted. Place weights upon cord at intervals to keep it in position. Drive in one of the pegs at each place marked by red yarn. When this is done one row will be completed.

Then take same cord and mark end of field at right angles to one completed in same way. Lastly mark remaining side.

To fill up hollow square stretch cord successively between corresponding stakes on opposite side, and continue until the whole is completed. If the work is carefully done, every stake will be in range.

Next take a strip of board about eight feet long and six inches wide and cut a notch in one side of the middle just large enough to let in the stem of the tree. Bore a hole in each end exactly equal distance from this notch. Then whenever a tree is to be planted, place the middle notch around the peg and drive other pegs in the holes at the ends. (See cut.) Then take up the board, leaving these two pegs; dig the hole, replace the board, and set tree in the notch. Proceed in this way until the whole orchard is set, and every tree will stand exactly where the pegs stood, and if the staking is properly done, every tree will range in all directions.

Dig holes with sufficient room to receive the roots of trees without crowding, and of such a depth that the trees can be planted six inches deeper than they grew in the nursery.

Before setting tree, trim from it all broken and bruised roots. Place loose soil in bottom of hole, setting tree upon it. Carefully with hands spread out the roots and work dirt around them, packing firmly all earth except surface layer, then fill hole two or three inches above the level of ground surrounding it, to allow for settling.

Trees received from a distance and injured from drying, as

they frequently are, to more or less extent, should have roots immersed in a bed of mud, and the whole tree buried in moist earth for a few days before planting. They will gradually absorb moisture and resume their freshness.

A tree out of ground is like a fish out of water. And long shipments are detrimental, and oft-times the trees are injured to such an extent that although they may live, yet they never make a really good tree or a tree that is long-lived. Especially is this true when the trees come from a considerable distance East, as their seasons are later, and in order to get trees before the ground freezes they must be stripped of their leaves and taken up while the wood is yet soft and not matured or ready to go into winter quarters. This applies to fall shipments.

SEASON FOR TRANSPLANTING.

Trees may be removed from the ground at any time between the cessation of growth in the fall and the swelling of the buds in the spring. It is the best plan to dig all trees in the fall, and heel them in at a convenient place of suitable conditions. There is a growing sentiment that the planter should get his trees from the nurseryman in the fall of the year.

HEELING IN TREES.

Select a dry, clean, mellow piece of ground, with no grass near to harbor mice, dig a trench, lay sloping and cover well around the roots so as to exclude the air as much as possible, and then cover the entire tree with earth. Have the roots of the trees covered to a depth of from eighteen to twenty-four inches. Fill in carefully all the interstices around the roots. You will then have your trees on hand to plant early in the spring as early as condition of soil and air permit,. Transplanting may be done in the early spring, at any time that the ground is free from frost, and the air is above freezing.

Always shorten the head or branches of trees to correspond with its roots. It is impossible in digging up trees to avoid leaving many of the roots in the ground. And the tree is set that way will be unable for a time to feed its leaves and branches. A part of the tops, therefore, must be cut off, to restore the balance corresponding with the loss of roots. This may be done by thinning out the branches, or cutting back all its branches. The growth of new roots depends upon the assistance of the leaves at the top. If the leaves are too few the roots will not grow freely. If there are too many leaves the roots cannot furnish a sufficient supply of food for them.

The relation between root and leaves is: The leaves cannot exist without the moisture and crude elements received through the root. And the roots cannot grow without the nourishment received from the leaf.

Different kinds of trees vary in growth and therefore must be differently treated at time of transplanting.

Peach can be cut freely.

Grapes can be cut freely.

Cherry should be cut lightly, if at all cut.

Pear moderately cut.

Apple moderately cut.

Plum cut freely.

Quince cut freely.

TABLE OF DISTANCES TO PLANT DIFFERENT VARIETIES AND NUMBER REQUIRED TO THE ACRE.

Apple—25 feet apart each way using 70 to acre; 20 feet apart each way using 110 to acre.

Pear—15 feet apart each way using 195 to acre; 12 feet apart each way using 300 to acre.

Peach—15 feet apart each way using 195 to acre.

Cherry—18 feet apart each way using 135 to acre; 15 feet apart each way using 195 to acre.

Plum—15 feet apart each way using 195 to acre; 10 feet apart each way using 435 to acre.

Apricot—15 feet apart each way using 195 to acre.

Quince—8 feet apart each way using 680 to acre.

Grape—8 feet apart each way using 680 to acre.

Gooseberry. in rows 5 ft. apart, 3½ ft. apart in rows, 2571 to acre.
Currants . . in rows 5 ft. apart, 3½ ft. apart in rows, 2571 to acre.
Raspberry. . in rows 5 ft apart, 20 in. apart in rows, 5227 to acre.
Blackberry. in rows 5 ft. apart, 20 in. apart in rows, 5227 to acre.
Strawberry in rows 3 ft. apart, 12 in. apart in rows, 14,520 to acre.
Strawberry. in rows 3 ft. apart, 18 in. apart in rows, 9680 to acre.

QUANTITY OF SEED REQUIRED TO PLANT AN ACRE.

Asparagus in 12-inch drills, 10 quarts; asparagus plants, 4 by 1½ feet, 8,000; barley, 2½ bushels; beans, bush, in drills, 2½ feet, 1½ bushels; beans, pole, Lima, 4 by 4 feet, 20 quarts; beans, Carolina, prolific, etc., 4 by 3 feet, 10 quarts; beets and mangold, drills, 2½ feet, 9 pounds; broom corn in drills, 12 pounds; cabbage, outside, for transplanting, 12 ounces; cabbage, sown in frames, 4 ounces; carrot, in drills 2½ feet, 4 pounds; celery, seed, 8 ounces; celery, plant, 4 by ½ feet, 25,000; clover, white Dutch, 13 pounds; clover, Lucerne, 10 pounds; clover, Alsike, 6 pounds; clover, large red, with timothy, 12 pounds; clover, large red, without timothy, 16 pounds; corn, sugar, 10 quarts; corn, field, 8 quarts; corn, salad, drill 10 inches, 25 pounds; cucumber, in hills, 3 quarts; flax, broadcast, 20 quarts; grass, timothy, with clover, 6 quarts; grass, timothy, without clover, 10 quarts; grass, orchard, 25 quarts; grass, red top or heads, 20 quarts; grass, blue, 28 quarts; grass, rye, 20 quarts; lettuce, in rows 2½ feet, 3 pounds; lawn grass, 35 pounds; melons, water, in hills 8 by 8 feet, 3 pounds; melons, citrons, 4 by 4 feet, 2 pounds; oats, 2 bushels; onions, in beds for sets, 50 pounds; onions, in rows for large bulbs, 7 pounds; parsnip, in drills 2½ feet, 5 pounds; pepper, plants, 2½ by 1 foot, 17,500; pumpkin, in hills 8 by 8 feet,

2 quarts; parsley, in drills 2 feet, 4 pounds; peas, in drills, short varieties, 2 bushels; peas, in drills, tall varieties, 1 to 1½ bushels; peas, broadcast, 3 bushels; potatoes, 8 bushels; radish, in drills 2 feet, 10 pounds; rye, broadcast, 1¾ bushels; rye, drilled, 1½ bushels; squash, bush, in hills, 4 by 4 feet, 3 pounds; turnips, in drills 2 feet, 3 pounds; turnips, broadcast, 3 pounds; tomatoes, in frames, 3 ounces; tomatoes, seed in hills 3 by 3 feet, 8 ounces; tomatoes, plants, 3,800; wheat, in drills, 1¼ bushels; wheat, broadcast, 2 bushels.

VARIETIES ADAPTED TO VARIOUS SECTIONS.

Growers differ somewhat in their estimate of varities, but the following lists will be useful in determining what varieties to plant in your locality:

Northern District.

Embracing the counties of Eagle, Grand, Larimer, Logan, Morgan, Phillips, Sedgwick, Summit, Washington, Weld, Pitkin and Yuma.

Apples—For Summer varieties: Red June, Yellow Transparent and Duchess. For Fall varieties: Wealthy, Utter Red, Plum Cider, Gravenstein and Jeffries. For Winter varieties: Ben Davis, Jonathan, Walbridge, Gano, Belleflower, Winesap, Missouri Pippin, Rome Beauty, N. W. Greening.

Crab Apple—Whitney No. 20, Martha, Hyslop, Florence, Shields.

Pears—Standard, Seckle, Tyson, Rossney, Flemish Beauty, Dwarf, Duchess, Bartlett.

Prunes—German, Italian, Silver, French, Hungarian, Pacific, Tennant.

Plums—De Soto, Eagle, Quaker, Sunset, Wyant, Weaver, Wolf, Cherry, Lombard, Moore's Arctic, Green Gage, Hawkeye, Peach Plum.

Cherries—Montmorency, English Morello, Dyehouse, Early Richmond, May Duke, Olivet, Ostheim.

Red Raspberries—Marlboro.

Black Raspberries—Kansas and Gregg.

Blackberries—Taylor, Wilson, Erie, Briton, Rathbun, Eldorado, Missouri.

Dewberry—Lucretia.

Currants—Versailles, Cherry, Red Dutch, Victoria, Fay, Red Cross, London Market.

Gooseberries—Downing, Champion, Smith, Pearl, Red Jacket, Smith's Improved.

Grapes—Delaware, Brighton, Concord, Warden, Moore's Early, Martha, Niagara.

Strawberries—Captain Jack, Warfield, Bubach, Clyde, Glauer, Dunlap, Jucunda, Bederwood.

In the Northern District, vines and small fruits, such as grapes, raspberries and blackberries, must be laid down during winter.

Southern District.

Embracing the counties of Baca, Bent, Chaffee, Cheyenne, Custer, El Paso, Teller, Fremont, Huerfano, Kiowa, Lake, Las Animas, Otero, Prowers and Pueblo.

Apple—Summer varieties: Yellow Transparent, Duchess, Cooper's Early White. Fall varieties: Wealthy, Rambo, Jeffries, Gravenstein, Utter Red. Winter varieties: Ben Davis, Gano, Winesap, Jonathan, Willow Twig, Missouri Pippin, Rome Beauty, N. W. Greening, York Imperial.

Crab Apples—Martha, Whitney No. 20, Shields, Florence.

Peach—Triumph, Alexander, Elberta, Stump, Champion, Lemon Cling, Heath Cling, Crawford Early, St. John, Wonderful.

Pears—Standard, Bartlett, Sheldon, Duchess, Flemish Beauty, Dwarf, Seckle.

Prunes—German, Italian, Silver, French, Hungarian, Tennant, Pacific.

Plums—Forest Garden, De Soto, Lombard, Moore's Arctic, Green Gage, Damson, Yellow Egg, Shipper's Pride, Wild Goose, Burbank.

Nectarines—Violet and Golden.

Apricots—Moore Park, Peach, Royal.

Cherries—Early Richmond, Wragg, Montmorency, Ostheim, English Morello, Dyehouse.

Blackberries—Snyder, Briton, Wilson.

Black Raspberries—Missouri, Gregg, Kansas.

Red Raspberries—Marlboro, Lunden, Cuthbert.

Currants—Cherry, Red Dutch, Fay, Red Cross, London Market.

Gooseberry—Smith, Downing, Red Jacket, Houghton, Pearl.

Strawberries—Bederwood, Warfield, Jucunda, Clyde, Captain Jack, Dunlap.

Grapes—Concord, Worden, Moore's Early, Brighton, Delaware, Agawam, Niagara.

Quinces—Orange and Champion.

Almonds—Princess Hard Shell.

Western District.

Embracing the counties or Archuleta, Costillo, Delta, Dolores, Garfield, Gunnison, Hinsdale, La Plata, Mesa, Montrose, Montezuma, Rio Grande, Rio Blanco, Routt, Saguache, San Juan and San Miguel. Parties planting at altitudes above 5,000 feet should use Northern District list, or correspond with some one familiar with the section in which you may want to plant.

Apple—Summer varieties: Early Harvest, Yellow Transparent, Red June, Chenango, Strawberry, Duchess. Fall varieties: Maiden Blush, Utter Red, Golden Sweet, Fameuse, McMahon, Wealthy. Early Winter varieties: Jonathan, Wolf River, Grimes' Golden, Smith's Cider, Rome Beauty, Huntsman. Late Winter varieties: York Imperial, Willow Twig, Ben Davis, Gano, Winesap, Lawver, Pearmain, Staymen, Missouri Pippin.

Crab Apples—Same as Northern District.

Pears—Wilder, Bartlett, Howell, Flemish Beauty, Keiffer.

Peaches—Arkansas Traveler, Hale, St. John, Crawford's Early, Elberta, Foster, Salway. (Elberta planted more extensively than all others combined.)

Plums—Wild Goose, Weaver, Miner, Lombard, Green Gage, Peach, Yellow Egg, Burbank, Bradshaw, Red June.

Cherries—English Morello, Early Richmond, Montmorency, May Duke, Black Tartarian, Wragg, Ostheim.

Apricots—Early Golden, Moore Park, Royal, Peach.

Nectarines—Violet, Snow Flake, Stamwick, Golden.

Grapes—Niagara, Brighton, Concord, Worden, Moore's Early, Sweetwater, Black Hamburg, Black Spanish, Purple Damascus, Flame Tokay, Thompson Seedless, Muscat, Malaga, Emperor, Seedless Sultana.

Gooseberries—Berkeley, Houghton, Chautauqua, Industry.

Currants—Cherry, Red Dutch, White Grape.

Raspberries—Gregg, Nemaha, Cuthbert, Marlboro.

Dewberries—Lucretia.

Blackberries—Missouri, Rathbun, Eldorado.

Central District.

Embracing the counties of Arapahoe, Boulder, Clear Creek, Denver, Douglas, Elbert, Gilpin, Jefferson, Kit Carson, Lincoln and Park.

Apples—Summer varieties: Duchess, Sops of Wine, Red June, Yellow Transparent, Early Harvest, Cooper Early White. Fall varieties: Wealthy, McMahon, Utter Red, Gravenstein, Jeffries. Winter varieties: Ben Davis, N. W. Greening, Jonathan, Winesap, Walbridge, Pearmain, Gano, Rall's Genet, Missouri Pippin, Rome Beauty.

Crab Apple—Martha, Whitney No. 20, Florence, Shields.

Plums—Lombard, Burbank, Weaver, Moore's Arctic, Bradshaw, Washington, Yellow Egg, Coe's Golden.

Prunes—Italian, German, Pacific, Pond Seedling.

Grapes—Delaware, Brighton, Lindley, Moore's Early, Worden, Concord, Niagara, Agawam.

Blackberries—Erie, Wilson, Briton, Taylor, Rathbun, Eldorado, Missouri.

Peaches—Elberta, Bokara No. 3, Crosby, Early Rivers, Early Crawford.

Gooseberries—Downing, Houghton, Triumph, Smith's Improved.

Currants—Fay, Red Dutch, Cherry, Victoria, White Grape, Red Cross, London Market.

Red Raspberries—Marlboro.

Cherries—English Morello, Wragg, Montmorency, Ostheim, Dyehouse, Early Richmond.

Strawberries—Bederwood, Champion, Crescent, Gandy, Jessie, Vick, Jucunda, Captain Jack, Clyde, Dunlap, Glauer.

Many varieties grown, which do fairly well in most localities, are not mentioned in foregoing lists. But upon inquiry of writer of this volume, you will be gladly and fully informed of just what you can depend upon having them do if planted in your locality. It is the intention to recommend to you only such varieties as have proven themselves to be the best of their respective kinds in localities mentioned.

We will now proceed to care of the orchard, as I feel assured the preceding chapters are simple and fully enough written to enable anyone to select and plant the orchard desired.

CULTIVATION.

Cultivation can be commenced as though the trees were a crop of vegetables, or cultivate them as you would any crop, using a cultivator and do it often, so as to keep down all weeds and grass which, if let grow, will take from the soil the strength and moisture the tree needs. Such crops as sugar beets, peas, beans and their like may be grown in your young orchard, always being sure nothing is grown within a distance of three or four feet from the trees in all directions, so the ground can be

kept loose and clean surrounding the trees for that distance. Corn has been found to be one of the best crops to be grown in a young orchard. The stalks acting as a shade and protection against winds to the young trees. But the stalks and corn must be removed from the orchard in the fall, so as not to furnish food for rabbits, mice and such pests, that would be attracted by them. By frequent cultivation you destroy surface roots and compel the roots of the tree to go deeper. It is very important that this cultivation begin at once, for should you neglect it and a large amount of surface roots let grow, and later on do your cultivation, the destruction of root at one time will be too great for the good of the trees. The trees must always be cultivated as though a crop of its own. And the only reason in permitting other crops to be grown in your young orchard is that you may secure a revenue by so doing from your land while you are growing your orchard. Do not think you can grow trees among crops because you can grow crops among trees, for you can not. This manner of cultivation should be continued until trees get to be of such size as to prevent it.

HAIRY VETCH AS A WINTER COVERING FOR ORCHARDS.

Under no conditions or circumstances is any one thing so beneficial in growing an orchard, as cultivation. Yet there are objections in some localities (especially if you have no wind-break) to having a clean piece of ground during winter, as the winter and early spring winds move the soil, if it be sandy. The writer has seen parts of orchards when the soil from several trees joining each other, had all been blown away from them, exposing the entire root system.

Many kinds of crops have been tried, but none fill the bill as well as hairy vetch. This can be sown in late summer or in the fall, and it will reach a sufficient growth to cover the ground well and catch the snows in winter, which is virtually storing water or moisture for next season's use.

The plant is easily destroyed and therefore will not become a nuisance. Sow in the late summer or early fall, and in the spring plow under and thereby add fertility to the soil. A crop of beans, peas or corn can be raised each year after plowing under in the spring, and the crop removed in the fall, and again sown in vetch. It will thrive on the lightest of sandy soils. Just the kind the winds move. Nothing as yet has been found to do the work it will, therefore it is the one thing recommended.

PRUNING OF FRUIT AND ORNAMENTAL TREES.

Composition for Wounds Made in Pruning.—One quart of alcohol and dissolve as much gum shellac as will make a liquid the consistency of paint. Apply this to wound with a paint brush, always paring the wound smooth first with a knife. Keep in a tightly closed vessel to keep from evaporating and getting too thick.

Apple Trees.—It is generally considered to be advisable to delay pruning until cold weather is past. The height from the ground at which the limbs are shortened usually is about one and one-half to two feet. But this can be varied to suit the ideals of the grower. However, high-headed trees should be avoided. From four to five limbs should form the scaffold or limbs branching from the trunk of the tree. When the form of the top has been established the subsequent pruning will be in removing superfluous limbs from center of top, and those that run crosswise and rub against other limbs, keeping the top thinned out so as to admit light and air, which develop and color the fruit.

Plum Trees.—Start top about two feet above ground. The fruit being borne upon spurs, heading in does not thin. Remove each year dead or damaged limbs.

Apricot Trees.—Treat same as plum. But do very little, if any, heading in.

Cherry Trees.—Methods used on plum and apricot trees apply to the cherry.

Peach Trees.—Heading in thins the fruit, which also induces new growth of shoots on which the fruit is borne. Trim out dead wood.

Pear Trees.—Pear trees grow upright and top should be started close to the ground to prevent damage of body from sun. The top can be thinned out very little each year. Heavy pruning not permissible.

Quince Trees.—Head low. Heading in thins fruit. Thin out top each winter by removing dead, damaged or superfluous limbs or branches.

Blackberries and Raspberries.—All bear their fruit on canes grown the previous year, which should be removed in the fall, leaving fifteen to twenty-five of this year's growth for next year's fruit bearers. When canes reach a height of three feet, cut off tip, which forces growth of side branches. Early the following spring these branches are to be shortened by cutting to desired length and removing all ends of canes or branches damaged by winter freezing or laying down.

COVERING RASPBERRIES AND BLACKBERRY CANES.

Plow alongside of row of plants a deep furrow and lay canes in it, all in one direction, covering same with soil which must be fine and loose. Care must be taken so as not to break or bruise the canes. The usual rule is for one man to lay the canes down, holding them there while others place ground upon them until sufficient ground has been placed upon them to hold them in position. Then finish with plow, covering them sufficiently so that all parts are protected. And see that they remain covered.

Second Method.—The above is the old method as largely practiced in many sections, but the Loveland growers have discovered a much better plan which leaves your ground in better shape when you are ready to plow under, viz.: first make into

stakes a lot of your old canes which you have cut out, or if your patch is new cut branches of trees about two feet long; now take canes of first hill and bend over to roots of second hill and bend canes of second hill back to roots of first hill. Now place a pin over the tops of the canes and into roots of each hill. Now take third hill and bend down to roots of second hill, pinning down, and so on through the entire row, pinning as you go.

Currants and Gooseberries.—The canes of both bear several seasons. The first two or three crops are the finest. Cut away after bearing two years, each year some of the old canes, so as to encourage new growth of canes and to keep plant from getting too tall.

Shade Trees.—When shade trees are once shaped to suit the idea of grower, all the pruning necessary is each year to remove

dead and damaged limbs and keep shape of tree. Original shape of tree should always be retained if possible.

Flowering Plants.—Come under two heads and require pruning at different seasons. Those to be headed back just after blooming are the Azalea, Snowball, Lilac, Mock Orange, Spirea, Wigelia, Barberry, Viburuum, Flowering Crab, Tree Peony, Almond, Syringia. Those to be headed back while in a dormant state, any time from the time the leaves have fallen until the buds swell in the spring are Roses, Clematis, Hydrangia, Hybiscus, Elder, Honeysuckle, Althea, Calycanthus.

STRAWBERRY CULTURE.

Prepare soil in the fall for spring planting. And in the spring for fall planting by applying twenty-five to thirty loads of well-rotted manure to the acre. Plow under and harrow and cross harrow, making it mellow. Mark out rows three feet apart and set plants twelve to eighteen inches apart in the rows, leaving the crown of the plant just level with the surface. Make the soil firm around the plant with foot. Irrigate immediately after planting. Hoe and cultivate frequently during the summer. When the first runners appear, cut them off. Always let plants go into winter quarters with plenty of moisture. As soon as the ground is frozen hard, cover the plants with a covering of light strawy manure. Before this covering is put on and before the ground freezes cultivate and leave a furrow between each row. When uncovering in the spring, pile surplus straw and manure in this furrow and let it remain there. When you irrigate the water runs under the straw and washes out the elements of the manure, and also acts as a mulch to hold moisture. After crop is gathered keep the weeds cut down (allowing none to go to seed), rake off and burn. Cultivate between rows, then apply a coat of well-rotted manure, spread evenly over the ground and harrow in well; flood the patch with water when dry enough; cultivate often; irrigate often and lightly.

ASPARAGUS CULTIVATION.

Procure from your nurseryman the number of plants wanted. Loosen soil to a depth of eighteen inches and make very rich with well-rotted manure. Mark out bed in rows three feet apart and place plants twelve inches apart in the rows. In planting, have the crown three inches below the level of the bed, covered with the soil to that depth. Cultivate every few days by raking well with garden rake, until plants show above ground, then use hoe.

For the first two years keep down all weeds and allow no asparagus to go to seed. Clean off in the fall and give heavy coat of manure with about three pounds of salt to every square rod of bed. The following spring you can begin to cut. As soon as the tip of a sprout appears at the surface remove dirt to about one-half inch above crown of plant, cutting off sprout at that point, placing dirt back again. Never allow any shoots to go to seed. In the fall proceed as you did the fall before and so continue and your bed will improve each year.

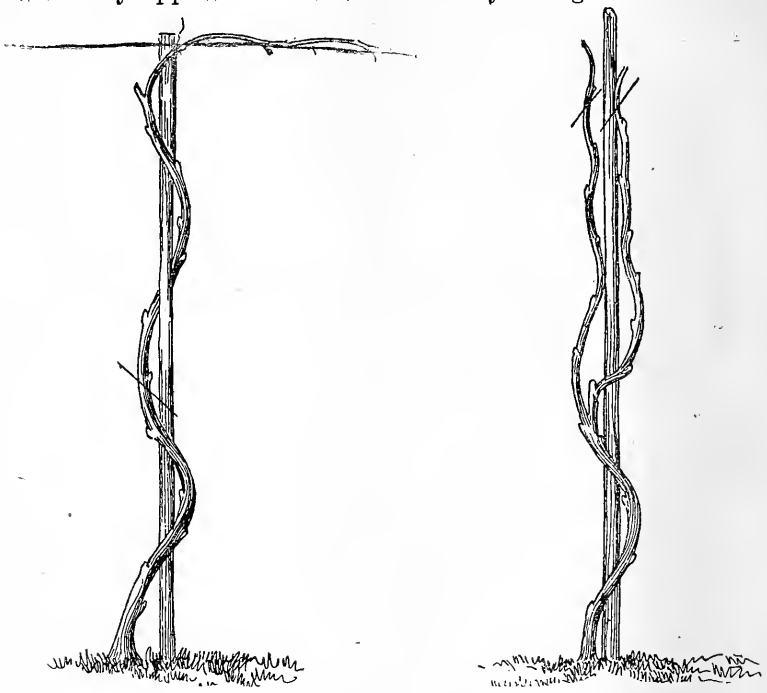
RHUBARB CULTIVATION.

Select a deep soil and enrich it with manure. Mark out in rows five feet apart and set plants three feet apart in rows. Cultivate and keep clean and well watered during the season; cover in the fall with heavy coat of manure well rotted. Continue same treatment each year for four or five years. By that time the plants will be so large that they should be taken up and divided, when better results will be had for the same period again.

GRAPE CULTURE.

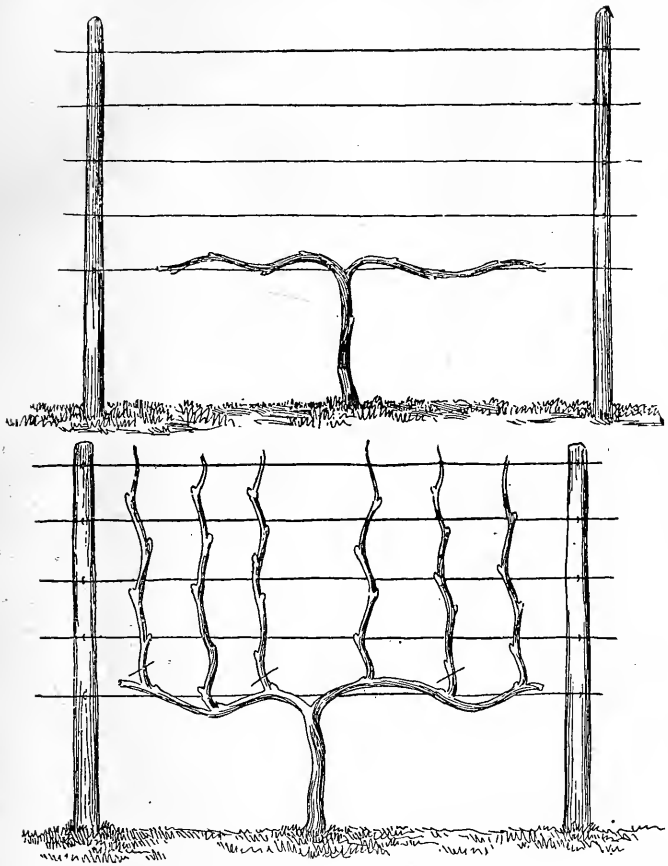
Prepare ground as for any other fruit. Plant in rows eight feet apart and put plants six to eight feet apart in rows. Dig the holes of sufficient depth to allow planting a little deeper than they grew in the nursery. Evenly distribute the roots so they will grow in all directions; fill in about the roots with well-pul-

verized soil firmly. Drive a stake of sufficient height and strength to bear weight of the vine for two years. Train vine as a simple shoot from which all side branches should be pinched off as they appear. At the end of first year's growth vine will



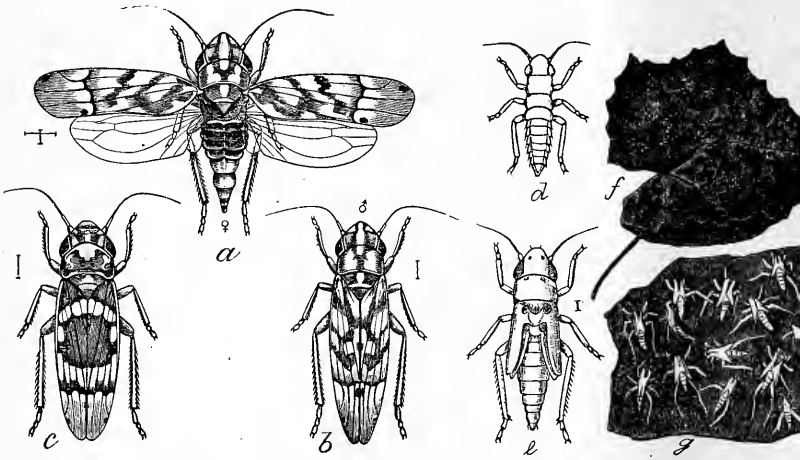
be a straight shoot, kept fastened to stake as it grew. Cut back in the fall to about two feet from ground.

Second season allow only two top buds to grow, rubbing off all others below them, and train the same as you trained single shoot last season. In the fall cut back these two shoots to two feet in length. The vine will then have its stem and two branches. The stake is now to be removed and a trellis support to take its place, which is built of wire and posts as you would a barbwire fence. Place the first wire two feet from the



ground and each wire one foot above, five wires in all will build the best trellis. No. 8 or No. 12 wire are the best sizes to use. Now raise your vine and fasten to bottom wire the stem and extend in opposite directions the two branches along bottom wire. The third year the shoots that spring from these branches train upward and make fast to each wire of the trellis. At the end of the third year the vine is fully established with its

permanent upright stem and its two horizontal arms. Each arm with its three or four shoots trained upward. Every other upright cane on both arms must be cut down to a short stump about three inches long and the balance cut off even with top of highest wire on trellis. The following spring a single shoot is allowed to grow from each stump trained vertically to wires above. Late in the fall, when there is no frost in wood of vine, the canes that have borne fruit should be cut down to short spurs a few inches from horizontal arms, and the shoots that have grown from the spurs the preceding year must be retained for fruiting next season. New wood in this way is grown each year for the next year's fruit.



Grape Leaf Hopper—Greatly Enlarged.

TO PROTECT YOUNG TREES FROM INJURY BY RABBITS.

Thin strips of wood as lath, proper length to reach high enough on body of tree, corn stalks or the like tied around the body will prevent rabbits from gnawing, as they can not get at body of tree without gnawing away the lath or corn stalk, which they will not do. This must be done early in the fall and re-

moved in the spring. Common window screen is effective. There are many washes, but none are absolutely effective. The following are good.

No. 1—Blood smeared upon trees as high as rabbits can reach will generally keep them away.

No. 2—Fresh cow dung, one peck; quick lime, one-half peck; flower of sulphur, one-half pound; lamp black, one-fourth pound. Mix the whole into a thick paste with soap suds and apply to body of tree.

No. 3—Aloes, one pound; water, four gallons. Painted on the body of the tree will, on account of its bitterness, prevent rabbits from doing much eating there.

No. 4—Asafoetida tinct., one-half ounce, in two gallons of liquid clay or mud brushed upon body of tree two or three times during the winter.

To Remedy the Evil Done by Rabbits by Gnawing the Bark of Young Trees.—Pare and clean the wound and cover it with grafting wax or with fresh cow manure and bind it up with burlap.

SHADE AND ORNAMENTAL TREES.

In Colorado our quickest growth and best shade trees are the Carolina poplar, Cottonless Cottonwood, Box Elder, Lombardy poplar, Russian willow, Elm, Ash, Black Locust, Norway and Sugar maple.

As ornamental evergreens Blue Spruce and Red Spruce have no equals.

The Mountain Ash and Cut Leaf Birch are both of no little value as an ornamental tree. The Catalpa, Speciosa, Locust, Maple, Ash, Elm and Walnut are all grown and do well. It has been the custom of a great many eastern orchard men to plant every thirtieth to fortieth tree in their orchard an Evergreen, to encourage birds to make the orchard their home. As no tree makes such an ideal sleeping place as an evergreen.

WIND BREAKS.

A wind break is intended to break the wind from the fruit orchard and anything that will do it the best is the best.

There can be no better tree planted that will make a better wind break than the cedar or spruce. Being an evergreen, they are always ready to do battle with the wind. But their only objection is their slow growth as compared to other trees that can be used. All orchards should have wind breaks planted at times of planting, on north and west sides. On those sides because the prevailing hard winds are from those directions.

The Carolina Poplar is, in my opinion, the best all-around tree for wind breaks that can be planted. Of quick growth, hardy and subject to less pests than any other.

The Cottonless Cottonwood comes next in line as a second choice. Also a quick grower, but more liable to be broken in storms.

The Russian willow is good, quick grower, and nothing bothers it.

The Locust is good, but not of very quick growth.

The Soft Maple is a rapid grower, but soft-wooded and liable to damage in storms and the raid of insect pests.

The question of cost, time or labor should not be taken into consideration when a wind brake is wanted. Nothing is too good for a wind brake. Many times the cost may be saved each year by keeping the wind from blowing the fruit off the trees and breaking them down when heavily laden with fruit or ice. Be sure and plant your wind brake at no later time than when you set your orchard.

IRRIGATION OF TREES AND VINES.

It is not worth while to discuss upon theoretical grounds or attempt to answer the general question: Should irrigation be employed and to what extent in the growing of trees and vines?

The true guide is local experience, and the test is the quality

and quantity of fruit produced. If your trees show no distress, or you are able to secure a fine quality and quantity of fruit without irrigation then you need none.

Some years, or may be most years, in your locality there is enough rainfall, and some years there is not enough. To be safe, provide for irrigation, and use it when you need it.

Irrigation or non-irrigation are not in themselves principals, but are methods to be employed when demanded.

If, by proper pruning, cultivation and thinning fruit, moisture enough is not provided, then irrigation must be resorted to. The amount of water needed depends on the local rainfall, soil, evaporation and condition and kind of crop. This must be determined by the grower himself. As two pieces of land, although they may join each other, may vary in their needs. It is difficult to answer the question so frequently asked as to how often a young orchard should be irrigated, on account of the varying conditions, but our experience is that an orchard on land that has never been cultivated before will require five or six times as much water as one on old land. The late fall irrigation is of the utmost importance and should never be neglected, because thousands of trees die for lack of moisture during the dry, warm days of our beautiful winters. The work necessary to grow a young orchard savors considerably of a continuous performance, but in a country like ours, where it begins to bear in three or four years and never fails, the reward is sure and large and compared with eastern states is much more quickly realized.

FRUIT GROWING WITHOUT IRRIGATION.

Very successful experiments have been made recently of growing cherries on the highlands of the foothills in Larimer county, Colorado. The orchards have borne heavily the past three seasons without any irrigation. The fruit has been excellently flavored and highly colored, demonstrating fully that cherries can be grown in Colorado without irrigation.

In this method of fruit farming much depends on the preparation and cultivation of the soil. And the rules and directions given must be followed as though you intended to plant where irrigation is needed.

E. R. Parsons of Parker, Douglas county, has been quite successful in producing a dry orchard. Trees planted in the spring of 1895 are now from ten to fifteen feet high, with a spread of from seven to ten feet. One lot of forty cherries gave a yield of 400 quarts last year. He has succeeded, without any watering whatever, in growing cherries, plums, apples, pears, currants, gooseberries and a few peaches. He plants very close in the row and heads as low as the habits of the tree will allow.

Mr. C. G. McWhorter of Masonville, Colorado, who has made a success of growing cherry above irrigation, contributes the following article on his methods:

Growing Cherries Above Irrigation.—In growing cherries without irrigation the most important part of the work is the preparation of the soil. You can not plow too deep or make too mellow. In my orchard I used four horses on stirring plow and followed with four on subsoiler. The first furrow was turned about nine inches deep and the subsoiler ran about as much deeper, making nearly eighteen inches in all. I then opened furrows as deep as possible with the plow, in which I planted the trees, and at the same time gave each tree at least two pails of water to settle the earth well about the roots. This I consider of the utmost importance in planting in dry ground.

After that trees were covered with the shovel sufficiently to hold in place. The furrows were filled with the plow, the earth being thrown up until the trees were on a ridge, leaving a hollow above each row to catch rainfall. In the cultivation of a dry orchard I think it well to run the subsoiler through at least once a year, running as close as possible to the trees without damaging roots; then give good, clean surface cultivation, often enough to give good mulch of dry soil. My orchard is now five

years old and has borne three crops, producing the past year 150 crates to the acre. At this writing, January 5, 1905, the trees are full of buds, giving promise of large crop the coming season. The trees are as well grown, healthy and productive as others I am growing under irrigation.

WINTER IRRIGATION.

Whether beneficial or not depends on your soil. If you have a deep soil you can use water in large quantities in winter. As you have a reservoir for storing water in the soil. But if the soil is shallow and underlaid with hard pan or rock, you have no storage for winter water, and you will have to depend upon summer irrigation as needed. The same condition will exist where your soil is underlaid with gravel or sand. And any great amount of winter irrigation will injure your soil by carrying off (as the soil is not deep enough to hold it) the strength of any fertilizers applied.

GATHERING, STORING AND MARKETING FRUIT.

For long keeping or storage, fruit must be picked early. For shipping, pick when the seed begins to get black and the fruit yields to pressure. The requirement of a fruit house for the storage of apples is an even cool temperature with moist air and good ventilation.

In selecting apples for storage, nothing but sound fruit carefully picked and handled should be kept.

The question of marketing time is a business proposition. And one man will succeed with poorer apples than another one may have, and fail all on account of his business ability along that line.

Corn, oats and general farm crops are always marketable at a given price, depending on grade. While to apples the same applies and in addition the manner in which they are picked, the

packing and grading. And at no time must they be handled or any attempt made to pick them when frost is in them. Frost or light freezing does not hurt them, if not allowed to be touched or handled while there is any frost in them. But just as sure as you attempt to handle them in that condition, just that sure you can be that they will not keep long.

Summer apples, of course, must be marketed as they become fit. And therefore the small orchardist must not plant many in excess of his own needs. Fall apples are some better in this respect, as they are used more freely than summer apples, excepting the very early ones. On account of there not being so many small fruits at this time of year, and in addition will keep better. So they can be more liberally planted. But the winter apple, on account of its being possible to keep, makes it the kind to grow, both for the market and the home. And the profit of same depends upon its quality and care, both in growing, keeping and marketing. But to be successful to the end, care and judgment must be exercised along all lines from the time you select your ground for planting orchard until you have used the fruit, or have the money in your hands from its sale. And the success you attain will depend on yourself. As the growing of fruit successfully will not permit of haphazard work, or occasional fits of enthusiasm, but must be a steady and continuous study and application of the same. The kind of packages you can use must be determined by your market in which you sell. This can be easily obtained by applying to any reliable wholesale dealer in fruits which you grow, and to whom you may ship. The poorest market as far as your net prices are concerned, is secured through commission men. Indiscriminate consigning of fruit is bad. If you intend doing any selling of fruit through a commission house, KNOW YOUR MAN. Never make a shipment unless you have corresponded, or in some manner found out from the person you intend to ship to, what he expects or can do.

Often it so happens that one point is overloaded with fruit as to amount to a drug on that market. While another is left unprovided with enough to meet the demands. This comes of senseless and worthless shipments. And had all of the shippers first written or got the condition of the market before shipping, both points would have been supplied and a fair price secured. Supposing, as an example, you usually buy your groceries or provisions from several dealers, and they should pursue the same method and all of them send you one dozen ears of corn, or one peck of potatoes, or a box of berries, or whatever they all might happen to have on hand? And you paid them for just what you needed or consumed. Their business would not be very profitable.

And when you ship to points or parties before knowing what you can expect or what the conditions are, your business is like the grocer's. Better both had allowed the goods to spoil at home than to pay transportation or supply consumers at a price that is a loss to you. The grocer comes around or waits for you to come to him to find out what you can use. A successful shipper also finds out what is wanted. This can be done by investigation as to the party to whom you ship, if he be honest or not, and have him keep you posted on his market. And should your crop be too large, have a number of such points from which you can be posted. But never under any circumstances will anything help you in disposing of your crop as the one thing, viz: reputation on packing and grading. Men will work up to such a reputation and then think anything from them will sell on account of their past reputation. But the result of such a proceeding always brings ruin and a reputation irretrievably lost. Do not understand that I would have you attempt to singly obviate the necessity of commission men. Not at all. They are a necessary evil, but dishonest ones should be left entirely alone. Indiscriminate consignments will not do it. In fact, it is that which makes and keeps up the rascal in commission business. The best and

only sure course to pursue is by combining or forming an association of fruit growers, and employing an able man to find your markets. This gives you all your time and attention to apply to grading and packing your fruit. The better man you employ, the better the result, as far as prices go. And the better you grade and pack your fruit, the better he can do for you. Because you may only be a small grower, do not think you need not belong to the association. That makes no difference. As, for example, fifty growers of 100 packages each are the same, as one grower of 5000 packages , and their combined output just equals the output of the one large grower. When the time comes that all growers of fruit form themselves into an association (not to combine for oppression) to combine to secure markets for your fruits at profitable prices, then, and only then, will you be free from the shark in the shape of dishonest commission men. But so long as you singly and promiscuously ship and consign your fruits, (and the greater the amount the greater you make the necessity for him to exist), you provide him with material to exist upon by independent action in shipping.

Some of you will say, why, this or that association is not very successful. I did, as well as they. You are the man, and others like you, who make it hard for the association to be successful. Whenever an association fails, you will find one of two things are to blame for its failure. One is dishonesty in its officials, and the other is so many independent indiscriminate shippers as to ruin the market. The forming, then, of an association, and the success of the same, entirely depends on you just as much as on any one other person, be you a small or large grower. Pay your manager a sufficient sum for his services so that he cannot afford to be dishonest. And all of you become members of the association, and your work will become profitable.

THE RIPENING AND PICKING OF CHERRIES.

During the year 1904 the writer knows of an orchard from which 3,000 crates were picked and shipped. And excepting three crates which were shipped to southern Texas and Mexico, every crate arrived at destination in saleable condition. The distances which they were shipped varying from 75 to 600 miles.

The methods pursued were as follows: About three to five days in advance of picking, each variety was irrigated. This fills out and perfects the cherry and helps to ripen it evenly. The time of doing this must vary according to moisture in the ground and condition of weather. If done too near the time of packing the fruit will be watery and not stand shipping so well A little experimenting will show just when to do this. And as necessary as this watering is, it is just so with picking. If picked too soon after watering, the cherry will be soft, and if delayed too long after watering it will have passed its true shipping condition. The picking was done by men, women and children. Each took a crate (made especially) that holds twelve boxes. Their boxes were put in the crates upside down, and taken to the tree to be filled. And the last thing done to them before filling, was turning them right side up. This cleans them of all dirt or trash that they may contain, and the box contains nothing when filled but fruit.

Each picker had a belt which has in the front a receptacle just large enough to hold an empty box. The box is placed in it, which allows both hands to be used in picking. And as the cherries are cut from the tree they are placed in this box until it is filled, when it is placed back in the crate used in carrying. When the twelve boxes (which fill a carrying crate) are filled, the crate is taken to the packing tent or house. The person in charge receives each one and issues to picker a card which entitles them to pay for twelve quarts of fruit picked. This tray of twelve boxes is looked over by packer and cherries graded, and placed in the regulation shipping crate of twenty-four quarts

and nailed shut, with each crate marked as to variety and grade. This gives the person in charge an opportunity of seeing each quart of fruit as it is packed, and also gives him the opportunity of knowing just who picked each box brought in. Then, if any bad cherries are shipped, only one person is to blame, and you know who that is. Of course it is the person in charge as he can set aside any box not properly filled or packed. The question of marking each crate (on end) stating just what it contains, is the correct thing to do. As an example, supposing you ship twenty-five crates of cherries to one firm, and upon arrival they are stacked up. The crates are all marked with only the variety they contain. And the person to whom they have been shipped opens one before his customers, and it proves to be of second grade, while it may be the only crate of that grade in the lot of twenty-five. Yet with no marks to prove it, why, the usual thing to do is to sell the entire lot upon the basis of grade of the one crate opened. There is where the shipper gets the worst of it. But if reversed, the buyer gets the worst of it. And both incidents are bad in the end to the shipper. This matter of grading is imperative, as good fruit looks better if all good; and the second grade also looks better by itself. And lastly the purchaser knows just what he is getting, and soon buys his fruit from marks upon the crate, knowing what he can expect the inside to contain. And any attempt to deceive him will forever destroy your reputation.

The crates and boxes were always given a sun bath or allowed to stand in the sun before being filled. But always kept in the shade while and after being filled with fruit. Each shipment was taken to shipping station to meet such train as made the proper connection with others which carried fruit to its destination. For when fruit is held over at any point of transfer, the care it usually gets is no help to it. And by holding it, or shipping as above stated, you suffer less by dangers in transportation.

By the issuance of tickets calling for the receipt and price to be paid to picker, not a single instance of misunderstanding occurred as to amounts picked or money due.

It is impossible, of course, to get all honest pickers all the time, so by a careful look at the fruit that comes in, and occasionally turning a box or entire carrying tray out, you will soon become familiar with the picker's methods of trying to decieve you, if he so tries.

Each picker was furnished with his outfit for picking every morning and taken back each evening, when the condition of it can be noted. And by this method not a single controversy was made necessary, or a single part of any one picker's equipment lost. Tents were used for receiving and packing the fruit, and were easily moved from place to place, so as not to make the distance too far for pickers to carry picked fruit and get empty boxes. Never, in any instance, was one picker allowed at one time, more than the one carrying crate of twelve boxes. The fruit by this means will be better handled and not too heavy to carry, and also comes to the packing tent sooner after picking. For if you will allow them more than one, they will be tempted to fill them all before bringing any of them in.

Picking devices were tried. But nothing proved so successful as a good pair of scissors kept in condition.

ROSES AND CLIMBING VINES AND THEIR CARE.

Roses on their own roots are preferable. And in ordering roses from your nurseryman, always ask for them grown in that way. As roses grafted or budded on rose stock are liable to sprout whenever, from any cause, the top becomes killed back. And in many cases the sprouts from the roots will kill off the grafted or budded portion of the rose, and you will have nothing left but a mass of sprouts of wild roses of no value.

In planting cut back to three or four buds and then place earth well up to top and let remain until roots start into growth,

say two weeks. If you do this you will have no trouble in making them grow. A warm, well drained spot sheltered from winds but unshaded by buildings is the ideal spot to grow roses. Keep the ground moist but not too wet. When the weather becomes dry and the sun hot, put on about one or two inches of mulching. Young plants require some protection at night until their soft stems have become woody. Also until well started, some protection from the hot sun is needed.

The pruning of roses will be found under their proper head in article upon pruning.

A good plan for winter protection is to lay the bushes down, pulling the tops outward, and lay flat upon the ground, like the spokes in a wheel, with the roots for the hub, and cover with earth. But in some places roses are so planted that this cannot be done. You must be governed by where your rose stands. And keep in mind that you want to get the plant covered for protection from winter, and do it the best way it can be done, careing not to break or damake the bushes any more than can be possibly helped.

Hybrid Perpetual Roses are the most valuable roses for outdoor planting wherever a permanent bed is desired. They are perfectly hardy and will stand out severe winters with little or no protection. However, in northern Colorado and the higher altitudes, they should be laid down and covered in the fall as recommended. We have found the following sorts to be the best: Anna D. Diesbach, rose color; Alfred Colomb, crimson; Baron de Bonstetten, dark red; C. D. Alps, white; Clio, flesh colored; Eugenia Furst, dark crimson; Francois Levet, rose color; General Washington, scarlet; Magna Charta, pink; Paul Neyron, rose; General Jacqueminot, dark red; M. P. Wilder, dark red; P. C. De Rohan, dark crimson; Ulrich Brunner, cherry red.

A class of roses known as Hybrid Teas are all hardy and with ordinary attention as to winter covering, do nicely, viz: La France, American Beauty, Dinsmore, Kaiserina A. V., etc.

The popular climbing roses are the White Rambler, Yellow Rambler, Crimson Rambler, Seven Sisters, Queen of Prairie and climbing General Jacqueminot.

CHRYSANTHEMUM CULTURE.

The Chrysanthemum is easily grown. If the plants are wanted to bloom only in the open ground, all that is necessary is to plant them in the open border in any good ground well enriched with manure. If possible, plant them in a warm, sheltered spot. A better development will be had if they are planted in a place sheltered by a fence or shrubbery. Plant any time in April or May. Pinch off the tops so as to make them bushy about August 1st.

If grown for house culture, put each plant in a pot seven or eight inches wide and deep. Sink these pots in the soil in open ground level with top, treat the same as directed for outdoor culture. Turn pots every few days to keep roots from coming out bottom of pot (as the idea is to keep the roots formed all in the pots). Take indoors about October 1st.

Early Varieties of Chrysanthemums: Bouquet National, white lemon center; Bouquet Fait, rose colored; Elaine, waxy white; Red Dragon, dark yellow, streaked bronze; Glorisun, bright yellow; Mrs. Brett, sulphur yellow.

Late varieties, house culture: Ben D., golden yellow; Cullingford, crimson; Christmas Eve, white; Fantasie, pink; Lady Shade, purple pink; Moonlight, lemon white; Maid of Athens, white.

ORNAMENTAL CLIMBING VINES.

Used to cover verandas, porches, arbors and walls, being found hardy, are among the following varieties: Honeysuckles, Virginia Creeper, Clematis, Wistaria, European Ivy, English Woodbine, Dutch Honeysuckle, Boston Ivy and Trumpet Creeper. And these may be successfully grown by using the same treatment as recommended for roses.

SOME BEAUTIFUL TREES FOR HOME GROUNDS.

Cut Leaf Birch, Teas Weeping Mulberry, Camperdown Elm, Wisconsin Weeping Willow, Weeping Ash.

PLANTING AND CARING FOR BULBS.

The Tulip: In planting a bed use all the early or late varieties separately. In no case plant or mix the early and late sorts in same bed. Plant in the fall, about three inches deep and eight inches apart in all directions. Before hard freezing weather sets in, cover the bed with leaves to a depth of four or five inches, which remove in the spring. When the bed is through blooming and the stems begin to wither, take up and dry the bulbs in the shade or a dark place, and keep in a dry place until wanted for fall planting.

The Hyacinth, Narcissus and Crocus bulbs are less hardy. The best results come from the best grade of imported bulbs. Keep bulbs over winter and plant in spring.

The Canna, Gladiola and Dahlia, after once you have a start, you can keep your bulbs over winter, from year to year. Plant in the spring.

It is an easy matter to keep bulbs safely through the winter if they are stored in a proper place. Dahlias require no more care than a potato and may be treated in much the same way. Cannas will winter nicely if dried off in the pots just as they have been growing, then cut back the foliage and set them in a warm, dry closet. They should not be watered until it is desired to start them into growth again. Too much moisture while in a dormant state is death to them. Tuberoses require a warm, dry place in which to winter. The temperature of the average cellar is altogether too low for their safe keeping, for if kept any length of time where it falls below fifty degrees, the flower germ will be destroyed, although the outward appearance of the bulb would be the same to the casual observer. It is generally supposed that if these bulbs are kept dry and free from frost that is

all that is required; but it is not enough to insure their blooming another season. They should be kept where the temperature of the room does not fall below fifty degrees, and if it rises to sixty degrees so much the better for the health of the bulbs. Tender bulbs, such as Gloxinia, Achimenes, Tuberous Begonias, etc., may be kept in a dry cellar. For Tuberous Begonias withhold water until the leaves drop, then set the pots away, keeping perfectly dry until spring. These bulbs would keep safely if removed from the soil and enclosed in paper bags, suspended in a warm place. The Gladiolus will keep nicely in the most ordinary cellar, providing it is frost-proof and the bulbs are not put away in a moist condition. Wrap in paper and suspend from the floor and they will keep safely.

PLANTS FOR HOUSE CULTURE.

The under-mentioned list of plants will be found desirable for house culture. In a temperature of from seventy to eighty degrees during the day with a decrease of ten to fifteen degrees during the night, the following are adapted: The Begonia, Tuberose, Jasmine, Dracaena and other palms, Hoya (wax plant), Coleus, Caladiums (ornamental leaved).

For a temperature of from sixty to seventy degrees during the day and ten to fifteen degrees less at night, the following will do well: Geraniums, Chinese Primrose, Heliotrope, Carnations, Fuchias, Calla Lillies, Rose Hibiscus, Verbenia, Amaryllis.

The following list will grow in a cooler temperature: Violets, Pansies, Mignonette, Cyclamens, Alyssum, Stocks, Chrysanthemums, Camellias and Pyrethrum.

If your plants are not doing well, investigate your temperature; perhaps too hot or too cold.

House plants are healthy for you if healthy for themselves. That is, a healthy-growing plant gives out pure oxygen and ozone, but a sick, diseased plant gives out malarious gases. Throw away sick plants. Health is one item to be considered in growing

house plants; cheerfulness another. They do us a great good by affording some pleasant occupation in the months that confine us. Window cases have gone out of style; but they are very fine things for all that. Have a glass case built to set down over a plot of plants—a stand two feet by three is a fair size. Under here you may grow ferns, or begonias, or caladiums, and almost any house plant, except heliotropes and geraniums. A larger case with a door is very useful. Gauge the size to the expense you care to incur. I have them built seven feet long and six feet high. A window case can be built with doors to shut when you sweep, if you care to stand the slight expense. Nothing hurts house plants more than dust in the pores. I recommend especially a small roof-garden built over a low story of the house, and covered with a lean-to of glass. These for cities are available and furnish not only flowers, but vegetables. I have seen them full of cucumbers, lettuce, pie plant, etc. Many farmers can easily add to their houses with home labor and slight expense a lean-to glass house which will be profitable for growing lettuce and other vegetables as well as flowers.

Try but few sorts. It is far better to have five handsome plants than twenty-five crowded. If much attention is paid to bulbs, I prefer tulips to hyacinths. The moment the first flower of a hyacinth spathe begins to decay, it emits a poisonous odor, a kind of a sensuous smell. A very fine effect can be made and much pleasure secured by growing a few tropical plants. I had an orange tree not two feet high with a dozen oranges on it, in all stages of development, yellow and green. There are flowers nearly all the time. The ficus elastica or India rubber fig is another grand and easily managed tree. One of the best vines is also a tropical, the philodendron, with great cut leaves. It is a bearer of fine edible fruit when it can be kept as high heat. The morning glory and the tropaeolum or nasturtium make easily-grown vines and bloom delightfully. Sow the seeds in the fall and they are soon on the climb and in full bloom. Of all

winter flowers, however, my own choice goes to the ordinary garden shrubs, forced. The best are the lilac, spirea prunifolia, deutzia gracilis and bush honeysuckles. Keep pots always clean and do not let any water stand in the saucers, except for callas. Water-soaked roots cause much disappointment in window plants. To keep bugs off, keep plants in good growth; they rarely attack a thoroughly healthy plant. They are scavengers. But if they do, use buhach and tobacco dust. For mildew, reduce the moisture and dust with sulphur. But there is nothing so generally useful as sprinkling your plants, say twice a day. When you do water, do it thoroughly; but do not be always putting on water. Use water about the temperature of your room.—Popular Gardening.

CANNING AND PRESERVING FRUITS.

Cleanse your cans thoroughly and test to see if any leak or are cracked. Provide a wide mouth funnel that just fits opening in top of can, and pour the fruit into the cans through this funnel.

The better your fruit is selected, the finer the products of canning and preserving will be. Large fruits, such as Peaches, pears, etc., are in the best condition for canning when not quite fully ripe. And they should be put up at once after picking. Small fruits such as Berries, should never stand over night. Use only the best sugar, in the proportion of one-half pound of sugar to one pound of fruit. Vary this rule, of course, with the sweetness of the fruit. In canning for pies, omit sugar, as the natural flavor of the fruit is better preserved without it. And some prefer this method altogether.

Fill your cans as full as possible and set aside for a few moments, when the fruit will have shrunk away a little. Fill up again with hot syrup, when the cans should be closed. Examine your canned fruit two or three days after putting up. And if any have leaked around the top, unseal and make into preserves, or use.

The following table will give you the time usually required to cook the different fruits and the quantity of sugar to use in canning:

Cherries—Boil 5 minutes, using 6 ounces sugar to 1 quart of fruit.

Raspberries—Boil 6 minutes, using 4 ounces sugar to 1 quart fruit.

Blackberries—Boil 6 minutes, using 6 ounces sugar to 1 quart fruit.

Strawberries—Boil 8 minutes, using 8 ounces sugar to 1 quart fruit.

Plums—Boil 10 minutes, using 10 ounces sugar to 1 quart fruit.

Whortleberries—Boil 5 minutes, using 8 ounces sugar to 1 quart fruit.

Pie Plant—Boil 10 minutes, using 8 ounces sugar to 1 quart fruit.

Small Sour Pears (whole)—Boil 30 minutes, using 4 ounces sugar to 1 quart fruit.

Bartlett Pears (halved)—Boil 20 minutes, using 6 ounces sugar to 1 quart fruit.

Peaches—Boil 8 minutes, using 4 ounces sugar to 1 quart fruit.

Peaches (whole)—Boil 15 minutes, using 4 ounces sugar to 1 quart fruit.

Pineapple (sliced)—Boil 15 minutes, using 6 ounces sugar to 1 quart fruit.

Crab Apples—Boil 25 minutes, using 8 ounces sugar to 1 quart fruit.

Sour Apples (quartered)—Boil 10 minutes, using 5 ounces sugar to 1 quart fruit.

Ripe Currants—Boil 6 minutes, using 8 ounces sugar to 1 quart fruit.

Wild Grapes—Boil 10 minutes, using 8 ounces sugar to 1 quart fruit.

Other Grapes—Boil 10 minutes, using 4 ounces sugar to 1 quart fruit.

Gooseberries—Boil eight minutes, using 8 ounces sugar to 1 quart fruit.

Quinces (sliced)—Boil 15 minutes, using 10 ounces sugar to 1 quart fruit.

Tomatoes—Boil 20 minutes, using no sugar.

PRESERVING OF FRUITS.

Preserves, to be perfect, must be made with the greatest care. Economy of time and trouble is a waste of fruit and sugar. The best are made by putting only a small amount of fruit at a time in the syrup after the latter has been carefully prepared and clarified.

Peel Peaches, Pears, Quinces or Apples and throw into cold water as you peel them, to prevent them from turning dark. It is difficult to watch a large quantity so as to be sure of its being done right. The old rule is a pound of sugar to a pound of fruit. This may be varied some providing the preserves are to be put into sealed cans, and three-fourths of a pound of sugar to a pound of fruit be used.

Quinces, Pears, Citrons and Watermelon rinds and many of the smaller fruits harden when put at first into a syrup made of their own weight of sugar. To prevent this, they should be cooked until tender in water.

In preserving such fruits as Apples, Peaches, Plums and Strawberries, and other fruits liable to become too soft in cooking, it is a good plan to pour the syrup hot over the fruit, or to sprinkle the sugar over the fruit and let stand a few hours. By either method the juice is extracted and the fruit hardened. Long boiling destroys the flavor natural to the fruit and darkens it.

To make the syrup for preserving fruit: Take one pound of sugar to one-half pint of water. Put the sugar and water in porcelain kettle. Just before it boils stir in the white of an egg beaten lightly with two tablespoonfuls of water, and as it begins to boil, skim off the scum which arises, with care to get it all. Boil until no more scum arises, and then add fruit. Then boil or simmer until the preserves are clear. Take out each piece with a skimmer and put into the jars at once. Continue to stew the syrup, keeping the scum which arises off until the syrup begins to become ropy (or ropes from the spoon). Then pour the syrup over the fruit that has been put in jar, and seal.

PUTTING UP FRUIT FOR EXHIBITION.

The formulas here given are recommended by men who have had experience in preparing fruits for exhibition purposes and who have made successful exhibits of fruits in solution.

The greatest care must be taken in selecting fruit, which should be in the best possible condition, without blemishes of any kind or injury from fungus diseases or insects. In doing this work it is necessary for the experienced person to experiment to a considerable degree before he can decide on any particular formula. After fruit has been selected, put in receptacle in which it is to be preserved. Cover with clean clear water and let stand six or seven hours, then pour off the water and rinse the fruit thoroughly, removing every particle of dirt from both jar and fruit. Then cover with liquid as described for that kind of fruit. Keep fruit in dark place for three to four weeks after putting up.

FORMULAS FOR DIFFERENT FRUITS.

Fluid No. 1—Formalin (or formaldehyde) one pound; water forty-four pounds; alcohol five pints. Allow the mixture to stand, and should there be any sediment, pour off clear liquid and filter the remainder.

Fluid No. 2—Dissolve one pound borac (borocie) acid in forty-five pounds of water. Agitate until dissolved, then add five pints of alcohol. Allow it to stand and settle. Pour off the clear portion and filter the balance.

Fluid No. 3—Dissolve one-half pound of zinc chloride in fifteen pounds of water. Agitate until dissolved, then add one and one-half pints of alcohol. Allow mixture to stand until it is settled, then pour off clear liquid and filter the balance.

Fluid No. 4—Sulphurous acid one pint; alcohol one pint. Allow mixture to stand and settle. Pour off clear liquid and filter the balance.

FRUITS, WITH KIND OF PRESERVATIVE TO BE USED

When two fluids are named, first is considered best.

Strawberries, use No. 2; Red Raspberries, use No. 2 or No. 1; White Raspberries, use No. 4 or No. 3; Black Raspberries, use No. 2; Blackberries, use No. 2; Red Cherries, use No. 1 or No. 2; White Cherries, use No. 4 or No. 3; Black Cherries, use No. 2; Gooseberries, use No. 1; Grapes, red or black, use No. 1 or No. 2; Grapes, green or yellow, use No. 4; Grapes, white, use No. 4; Apples, green russet, use No. 2; Apples, more or less red, use No. 2; Apples, white or yellow, use No. 4; Pears, russet, use No. 3; Pears, green or yellow, use No. 4; Plums, dark colored, use No. 1 or No. 2; Plums, green or yellow, use No. 4; Peaches, Apricots, Nectarines and Quinces, use No. 3.

THE APPLE AND HOW TO GROW IT

BY G. B. BRACKETT.

INTRODUCTION.

Every farmer, however small his possessions may be, who lives within the apple-growing districts of the United States, should have an apple orchard, the product of which should be found on his table in some form every day of the year. It is the purpose of this bulletin to present briefly some of the reasons why the farmers of this country should give more attention to the planting and care of their orchards; to aid them in the selection of orchard sites, of the varieties they may profitably plant, and of the trees that will prove most thrifty and productive; and to give information as to after care of orchards and the best use and disposition to be made of the fruit when grown and ready for family use or market. If this should stimulate the apple industry among our farmers, although it be only for home use, it will be a sufficient reward for the preparation and publication of this treatise.

The possible range of apple growing within the territory of the United States is very great. Perhaps two-thirds of the settled portion of our country is more or less adapted to the growth of this staple fruit, and within that range there are but few cases where the farmer is excusable if he allows his family to go hungry for apples.

HISTORICAL NOTES.

Although the apple (Pyrus malus) is not a native of American soil, it seems to find a congenial home here. It is true we have some nearly related species in our native crabs, and they

give promise in the hands of the experimenter of better things in the years to come, but as yet no specially valuable varieties have been developed from this source. Our cultivated apples and crabs are the lineal descendants of the wild crabs of Europe, Pyrus malus and Pyrus baccata, which have had many years of careful culture bestowed upon them to bring them to our present standard of excellence. When our American species have had as many years of domestic life and careful culture bestowed upon them they may rival their foreign cousins in many of their good qualities. In a short treatise like this, addressed as it is to the plain, practical farmers of our country, it may not be expected that an elaborate, scientific explanation of all the methods of improving and domesticating a wild species will be presented and discussed. It is deemed sufficient, therefore, under the present heading to say that the apple in its cultivated varieties as grown in this country is a foreigner, but, like the Caucasian race of man, has found a congenial home in the major portion of the United States and in large areas of the adjacent territory of British America.

USES OF THE APPLE.

So well known are the uses of the apple that little need be said upon this subject. No fruit known to the cultivator in the north temperate zone can take the place of the apple as a food product. Many other fruits, indeed most cultivated fruits, rank as luxuries, but the apple in most parts of the United States is one of the leading staple products of the farm.

In its numerous varieties its season of maturity extends throughout the year. No other fruit of the temperate zone may thus be had in continuous succession without resorting to artificial means of preservation. It is pre-eminently useful in the household economy. As a culinary fruit none excels it. It graces the table in a greater variety of forms than any other, and as a dessert fruit few are its equal and none its superior.

Its juice when extracted makes an excellent and wholesome beverage, and for vinegar it has no rival. As a market fruit it is one of the easiest and least expensive to handle, and usually finds a ready market if well grown and handled with that end in view.

Among the many ways in which the apple is now used, the manufacture of jellies and preserves is one of growing importance. The numerous factories for the manufacture of these goods which have sprung up all over the apple-growing region of the country have not only created a demand for second and third grade apples, but also for the waste products—cores and skins—resulting from drying and evaporating the fruit. It has been found that jellies made from this apple waste is almost as good as those manufactured from whole fruit. These waste products have not only a value for the uses above mentioned, but there is a growing demand for them for export purposes for the manufacture of cheap wines and cider.

Chops, for which there is also ready sale for export purposes, are made from the lower-grade apples by chopping the whole fruit into coarse pieces and converting by an evaporator into what is known as chops.

Apple butter of the real, rich, old-time farm product, not the thin, factory-made excuse, fills an important place in the household economy and always finds a ready sale at good prices.

Good sweet cider made from sound apples, not from half-decayed, wormy fruit, is one of the most healthful products of the orchard, and all surplus over and above what is needed for home consumption is always in demand at remunerative prices. It can be kept sweet and unfermented by heating it to a temperature of 160 degrees F. and holding it there for thirty minutes, then sealing it up tight in bottles or casks, to be put into a cool place.

Boiled cider made in the good old-fashioned way by reducing to one-fifth by boiling, and canned, makes an excellent arti-

cle for culinary purposes, for making apple butter, apple sauce, or for use in apple or mince pies. It also has a commercial value.

While the aim and purpose of the farmer should be to supply an abundance of fruit for his own family, he should also be able to offer to the outside world a liberal surplus. The apple orchard will often bring him better returns for his outlay than any other portion of his farm, acre for acre. The product of a single tree will sometimes sell for $10 or more, and fifty such trees can be grown on an acre of land. Though we may not always count on such large results, we may safely expect the orchard to do its full duty one year with another, especially if we first do our duty by it.

PROPAGATION.

We would not recommend the average farmer to propagate his own trees for planting, but it is well enough for him to understand something of the processes and methods of propagation commonly practiced. The natural method of propagation is by planting the seed of the fruit, but as a very large per cent. of seedlings are inferior in quality to the parent variety, the results are too uncertain to recommend for planters generally. Only the painstaking experimenter who wishes to originate new varieties can afford to practice this natural method of propagation.

Once having obtained a valuable variety and wishing to multiply and perpetuate it, one of several methods now in use must be resorted to for propagation. The methods more commonly practiced in growing young apple trees for planting in orchards are budding and grafting.

BUDDING.

With the apple this operation must be performed during the growing season, and consists in removing a bud from a twig of the variety which we wish to propagate and inserting

it beneath the bark of the stock or young seedling tree we wish to change; and this is then held in place by tying it fast until the bud and stock have united. Then by forcing the sap and consequent growth into this transplanted bud by preventing all other growth, we get a new tree of the desired variety. This we call budding. It is a method of artificially multiplying a desirable variety. The extent of this multiplication is limited only by the number of buds available. A budding knife and the successive stages of budding are shown in Fig. 1.

The main requisite for success in budding is a healthy, growing condition of the stock on which the work is to be done and a certain state of maturity of the buds. The bark of the stock must separate freely, so that the bud may be forced under it without injury to the cambium layer of either bud or stock. The bud sticks or scions selected for summer budding should be of the current year's growth and should have well-developed buds. When taken from the tree the leaves must be cut off immediately, leaving only a short stub of the leaf stem for convenience in handling during the operation. (Fig. 1, b). They should be kept in a fresh condition by use of damp moss or wet cloth until using, and not more than one or two scions should be withdrawn from the package at a time.

June Budding.—If it is desired to start the bud into growth the same season it is inserted, the budding should be done as early in the season as well-developed buds can be obtained. As soon as it is found that the bud has united with the stock or branch, the material used to fasten the bud in place must be removed and the stock or branch cut back to within a short distance from the bud, to force the growth of the inserted bud.

Late Fall Budding.—This is the kind of budding more commonly practiced among nurserymen, the buds being inserted into the stock as late in the season as the bark of the stock will separate freely to receive it. In such instances the bud remains dormant through the following winter. The following spring the

wrapping is removed and wherever the buds appear sound the tops of the stocks are cut back and treated in the same manner as described for June budding. All buds on the stocks below the one inserted should be rubbed off as they start to grow. The objection to early, or June, budding is that the growth from such buds does not always mature sufficiently in northern sections to pass a severely cold winter without injury.

GRAFTING.

Grafting, unlike budding, is usually performed during the dormant period of growth. It is performed by carefully fitting a small dormant twig or scion of the variety we wish to propagate into a cut in a stock or seedling tree which we wish to change. There are several forms of grafting, but they differ more in method than in results. In fact, so far as the top of the tree is concerned the results are the same in all cases whether we bud or graft. The object sought is to change an undesirable or uncertain tree into one which we know will produce a certain variety whose fruit will possess certain desirable characteristics.

Splice Grafting.—This is a simple form and is used when the stock and scion are very nearly the same size. It consists in splicing or lapping the scion on the stock by scarfing each at the same angle. (Fig 2, a.) When a close joint is secured the parts are held in place by means of some kind of wrapping material. (Fig. 2, d.)

Tongue Grafting.—This form differs from splice grafting in that both scion and stock are split at corresponding points on the scarf with a thin-bladed knife so as to form tongues as represented in Fig. 2, b and c. The object of this is to unite more firmly the two portions and present a larger surface for the effusion of cell tissue, and to promote the callousing process. is the method commonly practiced by nurserymen under the name of root grafting.

Root Grafting.—Thrifty one-year-old stocks grown from seed are taken up in the fall and stored in a cellar or buried in the soil, where they will keep fresh and be accessible at any time in winter when wanted. The scions having been secured in the fall, the work of grafting may be performed at any time during the winter. The roots only are used in this method and they may

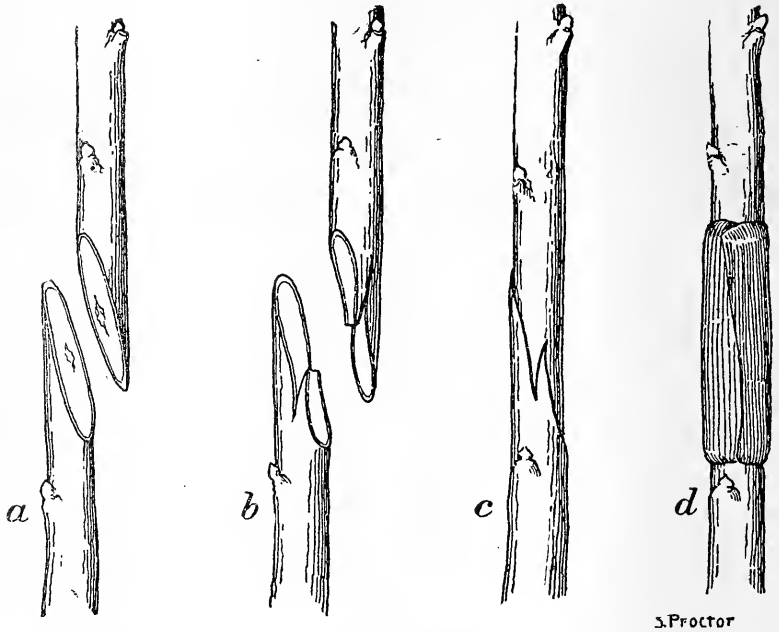


Fig. 2.—Successive steps of stock grafting; a, splice graft; b, tongue graft, separate parts; c, tongue graft, parts united; d, wax applied.

be cut in two or more sections according to their size and length or the desire of the propagator. But the larger or stronger roots as a rule may be relied upon for the most satisfactory results.

In the foregoing methods of grafting, but especially in the first, the parts must be held together by some kind of bandage or tie. This may be made of thin cotton cloth or tough manila

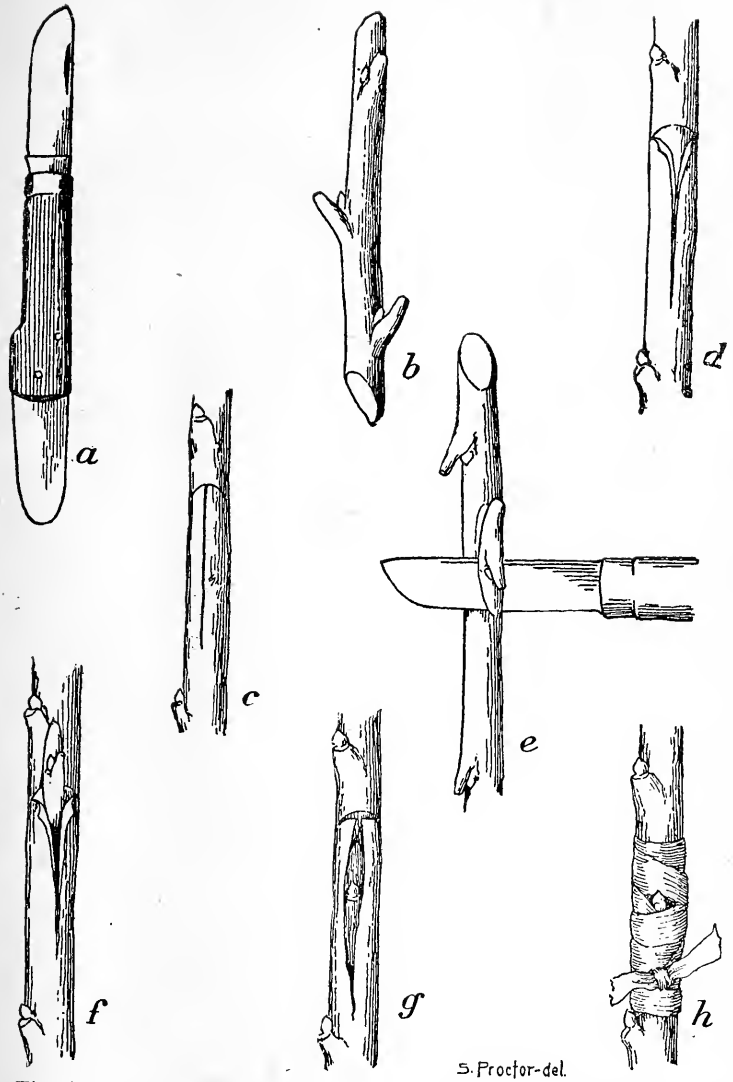


Fig. 1.—Budding: a, budding knife; b, bud stick; c, incision lengthwise with cross cut at top; d, opening of bark for insertion of bud; e, removing the bud; f, inserting the bud; g, bud inserted; h, tying in the bud.

paper spread with melted grafting wax and when cool cut or torn in narrow strips of convenient width for wrapping, as described in formula No. 2 for grafting wax. But the most common method now practiced is in using cotton yarn drawn

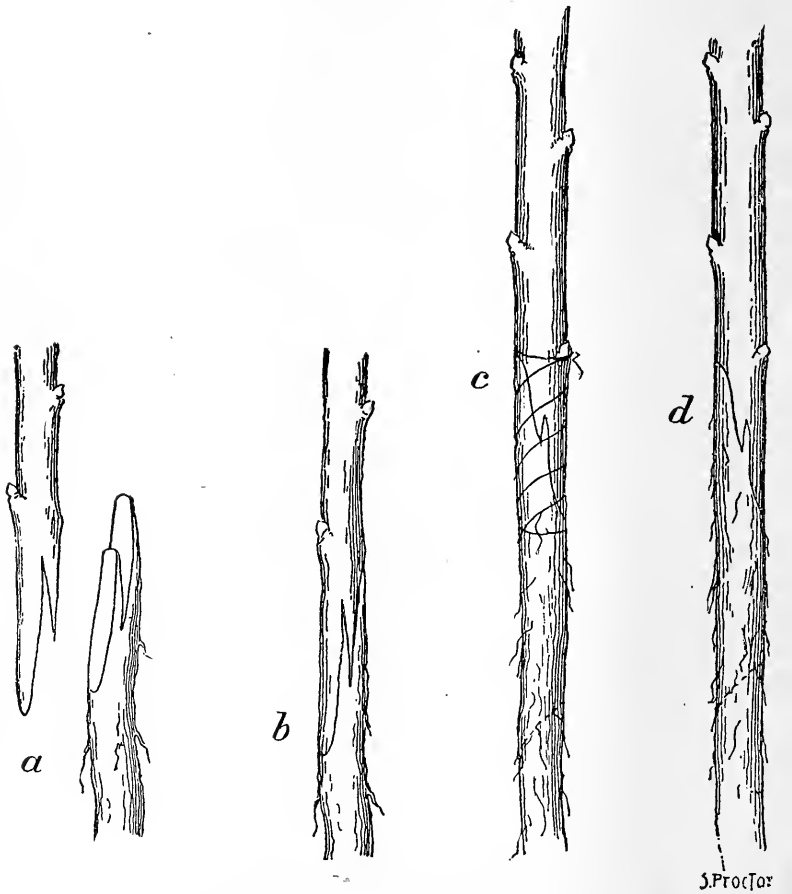


Fig. 3.—Root graftin: a, scion and root separate; b, scion and root united; c, scion and root united and tied; d, united scion and root with dotted line showing where root may be divided.

through melted wax and wound upon a spool, from which it is used when wanted (Fig. 3).

These root grafts, after having been tied in bundles, with each variety separately labeled, may be packed away in moist earth or loam and left in the cellar free from frost until spring, when they should be planted in nursery rows in the open ground and cultivated for one, two, or three years, when they are ready to be transplanted to the orchard site.

Thorough cultivation in the nursery rows should be given, and some attention should be paid to training or shaping the young trees, so as to insure the best results when transplanted in the orchard.

Top Grafting.—The top working of orchard trees is concerned with the insertion of buds or scions in the tops of the

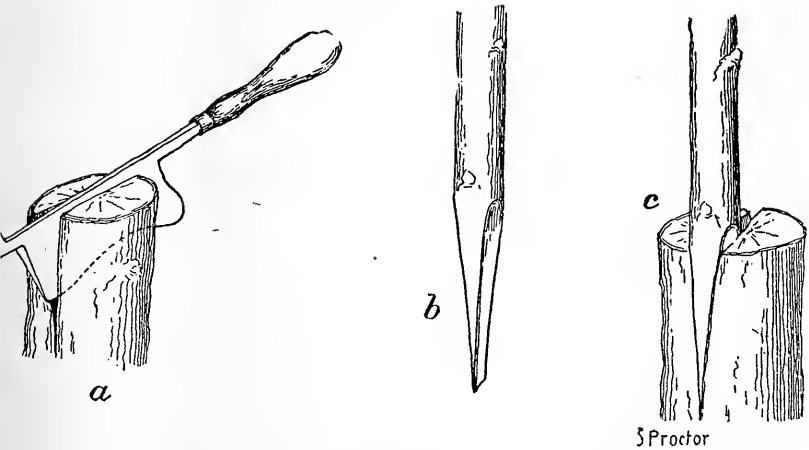


Fig. 4.—Cleft grafting; a, splitting the stock; b, scion prepared for insertion; c, scion inserted.

trees after they are established in the orchard. It may be practiced upon trees of bearing age which it is desirable to transform into better sorts; or it may refer also to trees recently planted which may be top-worked for other purposes. The fruit

grower may have planted varieties that are not adapted to his climate conditions, or when the orchard reaches bearing age, may find that the varieties are not true to name and are inferior or even worthless. In many of the orchards that have been planted, the trees are of varieties that were brought from sections having entirely different climatic conditions, and as they are not adapted to your locality, the orchards have been unprofitable. Under any of the conditions mentioned, it may be possible to convert the orchard into a paying investment by top working the trees with buds or scions of better kinds, and it is this form of top working that is most widely known and practiced. Top working may be useful also in building up broken down tops of highly prized trees. It may be employed in grafting varieties into the tops of self-sterile trees to insure cross pollination. It may be practiced in reforming the tops of trees like the peach, and it is especially useful in testing new varieties by bringing them into early bearing by top working them into bearing trees.

Grafting Wax and Tools Used.—Grafting wax No. 1; one pound of tallow; two pounds of beeswax; three pounds of rosin. Mix all together, heat to boiling point, stirring constantly, and then dump into a tub of cold water. Then work like taffy. Use warm. Grafting wax No. 2: The common grafting wax of the French gardeners is of two kinds. The first is melted and laid on with a brush in a fluid state and is made: Pitch one-half pound; beeswax, one-half pound, cow dung, one pound.

The second which is spread while warm on strips of coarse cotton or strong paper, and wrapped directly around the graft, answering at once to tie and protect it. It is composed of equal parts of beeswax, turpentine and rosin.

Cut the limb off square and smooth with a sharp fine-toothed saw. Then split stub to a depth of two or two and one-half inches with grafting chisel. Then reverse chisel and drive in wedge to hold cleft open while grafts or scions are being placed

in position (as in cut shown). Push scions down to first bud or deeper and have fit tightly. The line of separation between the bark and wood in the scion must meet the similar line in the rock. similar line in the stock.

Cover the wounds and the top end of scion with wax so as to completely exclude the air from the entire wound made. It is customary to insert two scions, one on each side of stock (or limb) cut for top grafting.

The practice of top grafting is a success when a tree has fruited and the fruit has not been found desirable or valuable as the tree has grown and can have its entire top removed and any desired variety grafted upon it. Top grafting is done in the spring. The best time being when the leaves are just coming out.

Scions are always taken from mature wood of the previous season's growth. Only the lower, maturer portion of the shoot can be used, as the upper part is nearly always immature and consequently fails to grow. The number of scions that can be cut from one twig will depend on its length; ordinarily they are made about four inches long.

WHOLE OR PIECE ROOT GRAFTING.

Which has had extensive airing all over the country. When brought down or boiled down to its true position amounts absolutely to the following:

In an arid country like this the best trees are obtained by using scions six to eight inches in length with a shorter section of apple seedling and the development of more scion roots. This method gives the strongest, hardiest and most abundant root system to withstand the peculiar disadvantages of our dry winters. By using a limited number of varieties and establishing them on strong, vigorous root systems of their own they become much superior in hardihood to those miserable things known as root grafts in which the whole seedling is used in propagation

with the result that the root has only the variable hardihood of the seedling. We have noticed that certain varieties like Genet, no matter how grafted, always develop tap roots and we are further convinced that the root of a tree is largely under the control of the scion which develops roots in accord with its own habits. We all know the habit of the black walnut. This tree has deep tap roots which, when cut off by digging, resume their effort to penetrate deeply into the soil. A friend of ours over on the western slope recently dug out some peach trees and found that they had rooted from six to eight feet deep in the heavy adobe soil in which the orchard was planted. Each tree naturally endeavors to develop roots in accord with its own system. While budding is excellent for the east where the ground in winter is covered and the roots are protected by heavy snow, in the arid regions constantly subject to dry winters, we see the utmost need of developing scion roots with the hardihood belonging to the tree.

At the meeting of the Kansas State Horticultural Society last December, the subject of "Whole vs. Piece Roots" came up for discussion. It was the general opinion that nothing is gained by planting the more expensive whole root trees. President Wellhouse gave his experience as follows:

"In 1876 we planted out about 30,000 grafts and some 4,000 or 5,000 of whole roots. We had heard a great deal about these whole roots, so we planted about 5,000. We ran a dead furrow and put the lister in and made the furrow just as deep as we could get it, and when we planted the whole roots we had to take a spade and dig down still further. We took them all up at two years old and planted about 30,000 which were from piece roots of the usual length—two inches. In the orchard there were two rows of Missouri Pippins and two rows of Ben Davis on whole roots planted in the spring of 1878, and growing there now. If any man can tell the difference, he can do more than I can. The only difference I saw in that time was that the whole roots

sent up more seedling sprouts and caused us lots of work, but so far as the longevity of the trees was concerned we could see no difference. But they were terrible things to sprout. About nine-tenths of our two-inch roots, when we took them up from the nursery, had sent out roots from the scion, and the more we experimented in that line the more we desired them that way; and from that time on we have used only short roots, to get the roots from the scion, and have always been satisfied with them. Whenever you pay one mill more for a whole root than a piece root you are out just that much money. We examined the trees that had the short piece of root and found the roots above the graft hardy and vigorous. It reminds me of a potato. After the potato vine is well started the old piece of potato is there, seemingly alive, yet it is of no apparent use after the potato has sprouted. It is the same with the old apple roots. I have examined them after five years and found the two-inch piece of root in the same condition as when planted, while the new roots all came out from the scion and made them healthy trees on their own roots. We have practiced and watched this matter for about twenty-five years. The whole root business is one of the biggest humbugs ever perpetrated on credulous people."

Prof. W. L. Howard of the Missouri State Agricultural College says on the subject of whole and piece roots: "Experiments conducted by the government fruit stations, after experience with four years' growth, conclude there is no difference in the growth and vitality of a tree, whether grown from whole or piece root graft and that whether nursery stock is called whole root or piece root."

The whole root argument has been made in most, if not in all cases, by nursery salesmen solely to secure orders. Not that their nurseries grew them extensively. And experience along this line has developed the fact that a long scion and a piece root are the exact thing for this arid climate.

LAYING DOWN OF PEACH TREES

BY WENDELL PADDOCK.

Peach growing, from a commercial standpoint in Colorado, is largely confined to the western slope of the mountains. The trees find a congenial home in many localities in several counties, consequently large areas are devoted to the cultivation of this fruit. Peaches have been extensively tested in various fruit sections east of the mountains, and in the Arkansas valley in particular an occasional fine crop is produced. Indeed some of the best exhibits at the State Fair last fall were grown in this section. But in four years out of five, perhaps, late spring frosts or extreme cold in winter destroy the buds. North of the Valley, peaches are rarely produced unless the trees are protected in some manner.

This experience, when success was just within reach, stimulated the growers in their efforts to overcome climatic conditions. Various devices were tried for protecting the trees during the winter and spring. These included wrapping the trees with cloth or covering with corn stalks, evergreen boughs, boards and, in fact, most anything that was at hand that might afford protection, but after several years trial, these methods were found to be of little use. In the fall of 1896, Hon. W. B. Felton, of Canon City, began experimenting with laying trees down, using two trees in this first trial. Mr. Felton was closely in this work by Mr. C. C. Rickard, also of Canon City, and to these two men belong the credit of working out this system of protecting trees in Colorado. And, in fact, after a rather hasty consultation of horticultural literature, I do not find any record of this method of protecting trees having been tried at an earlier date.

From this modest beginning an industry has sprung that is

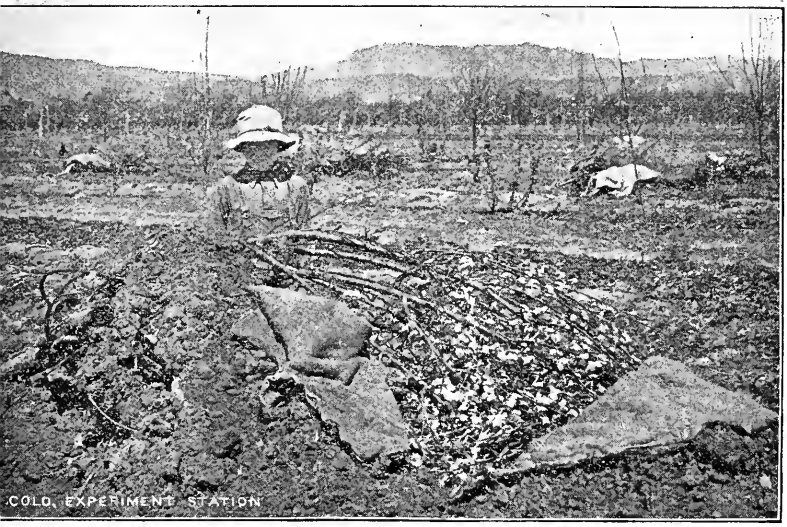


Fig. 1.—Three-year-old tree in full bloom.

Fig. 2.—Mr. C. C. Rickard in his ten-year-old orchard.

now assuming no mean proportions in that vicinity. A large number of fruit growers have planted peach trees varying from a few to several hundred in number. Mr. Rickard is, perhaps, still the largest grower, having now 1,000 trees in bearing.

The method of planting an orchard with the intention of laying the trees down during the winter, does not differ materially from that which is ordinarily observed. Some, however, claim that when the tree is planted the roots should be spread out on either side of the tree at right angles to the direction in which it is to be laid down. Mr. Rickard pays no attention to placing the roots, claiming that in a few years the roots spread so that any evidence of training is lost. Others make a point of setting the trees close enough in the row so that when laid down the tops of one tree shall overlap the base of another. The roots are thus afforded protection as well as the tops.

The following data furnished by Mr. Rickard is given in detail as it represents the experience, not only of the largest grower, but of one who has had the longest experience in this method of growing peaches. As is true with many horticultural operations, there are different ways of doing the same thing, consequently other growers differ with these instructions in points of minor detail, but in general, the process must be the same.

Yearling trees are set in the spring and they should be laid down the first winter, repeating the process each season during the life of the tree. In this instance no attention is given to training or placing the roots. As soon as the trees have shed their leaves and the wood is well ripened, they are ready for winter quarters. This is usually in the fore part of November, in the vicinity of Canon City. The first step in the operation consists in removing the earth from a circle about four feet in diameter around the tree. When sufficient trees have been treated in this manner to make the work progress advantageously, water is turned into the hollows. After the ground has become saturated, the trees are worked back and forth and the

Appearance of same row on April 25 and on September 20.
Orchard of J. J. Lewis, Canon City.

they are pushed over in the direction that offers the least resistance. When treated in this manner the trees go over easily and water follows the roots, loosening the soil around them so that with comparatively little injury to the root sysem. That is, providing he trees have been laid down each year. It is difficult to handle old trees in this manner that have never been laid down, and usually it will not pay to try.

After the trees are on the ground, further work should be delayed until the ground has dried sufficiently to admit of ease in walking, and in the handling of the dirt. The limbs may now be brought together with a cord, and so lessen the work of covering.

After experimenting with many kinds of coverings, burlap held in place with earth has proved the most satisfactory. The burlap is spread out over the prostrate tree top, as shown in the photographs, taking special pains to protect the blossom buds from coming in direct contact with the earth covering. A light layer of earth is now thrown over the tree and the protection is complete.

The critical time in growing peaches by this method is in the spring when growing weather begins. Close watch must be kept to see that the blossoms do not open prematurely, or that the branch buds are not forced into tender, white growth. When the blossom buds begin to open, the covering should be loosened so as to admit light and air, but it should not all be removed. More of the covering should be removed as the weather gets warmer, but the blossoms must be exposed to the sun gradually.

Air and light are, of course, necessary for proper fertilization of the flowers, but after this process is complete and the fruit is set, all danger from the weather is considered as being over. The trees are usually raised about the middle of May at Canon City.

Raising the trees is, of course, a simple task. The ground is again watered and when wet enough the trees are raised. To

be sure, trees that have been treated in this manner will not usually stand upright unsupported. Consequently they are propped up at an angle, usually two props being required to keep the wind from swaying them.

When this method of growing peaches was first presented before the State Horticultural Society by Senator Felton, it was received with not a little sarcasm by some of the members, but the practicability of laying down trees is now no longer questioned. The constantly increasing acreage of peaches at Canon City proves that it pays. The actual expense is, of course, difficult to estimate, because of the attention required in the spring. The cost of the fall work can be estimated, however, as it has been found that two men will lay down and cover twenty-five of the largest trees in a day.

This process seems to be in no way detrimental to the health of the trees, since they live as long and bear as much fruit according to size of the top as those grown in peach sections. It is, of course, necessary to cut out the wide spreading branches and thus reduce the size of the top in order to lessen the work of covering.

The following is the record of yields as given by Mr. Rickard: In 1902, 150 ten-year-old trees and 350 nine-year-old trees produced fifteen tons of fruit, or at the rate of sixty pounds per tree. In 1901 the yield was almost the same, but in 1900, twenty tons, or eighty pounds of fruit per tree was secured.

The marketing of peaches grown on this farm has thus far been a simple matter, as most of the fruit is sold at the orchard, and at prices ranging from 3 cents a pound for culls to 10 cents for fancy stock, the average price being 6 cents a pound. So long as the fruit can be sold in this way the expense of packages is reduced to a minimum.

But how about growing peaches in this manner north of the Arkansas valley? Can it be done? Most assuredly it can, and it is done every year, but only in a small way, and the trees are

so few and in such widely separated neighborhoods that they attract little attention. The most successful attempt of which I know has been made at Berthoud, a town fifty miles north of Denver, by M. H. Warfle. Mr. Warfle's experience is summed up in the following paragraph:

"I have thirty peach trees. In 1901, the second year after planting, I had about twenty-five boxes of fruit. In 1902, fifty boxes, and the outlook is good for a big crop this year. The varieties I grow are Alexander, Triumph, Mountain Rose, Bokara No. 3 and Elberta. Any good variety will do well if they are laid down."

These few pages are written not with the idea of presenting anything new, but to draw attention to the fact that peaches can be grown with a certain amount of profit in most of our fruit growing regions. But the pleasure to be derived from a home supply of this luscious fruit should not be underestimated. The peaches grown at Canon City always command a higher price on the home market because they are of better quality when allowed to ripen on the tree. Those that are shipped in must be picked before fully ripe in order to stand transportation.

In many parts of the state the price of peaches is so great that many families are compelled to do without. But by using this method of laying down the trees, as worked out by the pioneer fruit growers of Canon City, the small land holder can provide his family with peaches of much better quality than can be bought on the market, and with little expense.

MECHANICAL INJURIES TO WHICH FRUIT TREES ARE SUBJECT

By C. S. Crandall.

The disease we have attempted to discuss is only one of the many sources of injury to which our fruit plants are liable. Aside from the numerous insect pests which are demanding constant attention, we have a long list of parasitic fungi, and certain other mechanical injuries which result from peculiarities of climate. Some of these deserve brief mention here.

The mechanical injuries referred to are commonly spoken of as "frost-crack" and "sun-scald," and both are referred to a combined action of sun and frost. Most of the cases of so-called sun-scald that have come under my observation have proved to be cases of blight upon the trunk or large branches. They are characterized by dark, discolored areas of dead bark, commonly circular or elliptical, but sometimes irregular in form, and most frequently, though not always, on the side exposed to the sun. The dead bark as it dries shrinks and adheres closely to the wood.

Frost cracks occur upon the exposed side of the trunk, extending longitudinally. They are produced in winter and early spring under the influence of extreme low temperatures, and may, when growth starts, close and entirely heal. The liability of trees to injury of this character depends mainly upon the amount of water contained within the tissues. Trees that grow late, and enter the winter with wood not thoroughly ripened, and hence containing more water, are more susceptible to injury than those that are enabled to ripen and harden the wood. Even well ripened wood contains normally about forty per cent. of water. Trunks of apple trees cut on the 15th day of January,

1897, when last weighed, on the 8th of January, 1898, showed a loss of water by air drying of 39.36 per cent. and branches from the same trees lost in the same time 42.24 per cent. The weights are not yet quite constant, but the figures may be taken as an approximate showing of the moisture contained in normal issues in midwinter. But this moisture is not in the easily freezable liquid form; it is distributed as a constituent of cell wall, and in the viscid or solid cell contents, and can only be withdrawn and crystallized under the prolonged action of extreme cold. Suppose a tree thus normally constituted to be subjected, during the winter or early spring, to a period of warm, bright weather. The influence of the sun's rays penetrates the tissues, the cell contents become less viscid, water taken in by the roots still further liquifies these cell contents, there is movement within the cells and they become turgid with fluid sap. A sudden change marked by temperatures below zero occurs. There is a gradual shrinking of the tissues until the point of actual freezing, or crystallization is reached, and then comes that familiar and seemingly resistless expansion. If the sap-gorged tissues escaped rupture during the process of shrinking they are sure to yield to the expansive force accompanying congelation.

This form of injury is usually worse on plums, cherries and peaches, than upon apples and pears. The cracks are less likely to heal; they more often increase in size, and the exudation of gum is followed by rot which leads to the death of the tree.

With all trees this trouble can be in large measure prevented by providing some protection against the sun. This protection is most needed when the trees are young; as they attain size they in a measure protect each other. Various devices have been used, but we find wrapping with burlap the cheapest and most effective. Burlap that has been used for baling was purchased at dry goods stores at 2 cents per pound. One pound supplies twelve strips four inches wide and three feet long, and

one strip is sufficient for a reasonably low-headed tree three to five years in orchard. The burlap being cut and strings of proper length at hand, one man will wrap the trees at the rate of sixty an hour. The cost is thus nominal and the protection afforded ample.

More serious than the frost crack is that mechanical injury which is characterized by a separation of the bark from the wood. It has thus far been reported upon apple trees only, and most of the cases of which I have knowledge occurred in the southern portion of the state.

The separation between wood and bark in those cases examined occurred near the ground, and was not noticeably confined to any particular side.

In most cases the bark appeared discolored over a portion of the separated area, and more or less ruptured as if from lateral tension in drying. Between the discolored portion and the limits of the affected areas the separated bark often appeared perfectly healthy, and in some cases new growth was protruding into the space between bark and wood. A few cases were found that gave no visible sign of injury beyond a slight change from the normal color of the bark. There was nothing to indicate the size of the affected areas; the bark was smooth and apparently healthy, but when struck emitted the hollow sound that proved a sure test of the extent of the injury. In cases of this kind it would seem that considerable time might elapse between the working of the cause and the discovery of its effect, and I apprehend that the first evidence of injury would be seen in a generally unhealthy appearance of the foliage of the tree. Of course, if the trunk was affected to the extent of girdling it, the tree would soon die. If the affected area was confined to one side the tree might endure for some years, but with vitality diminished in proportion to the extent of the injury.

Where small areas only are affected the tree may by the intrusion of newly formed tissue, completely cover the denuded

wood and thus effect a cure. From the location of this trouble beneath the bark, and from the tardy appearance of any evidence of injury, it is clear that a practical demonstration of the cause would be difficult if not impossible. I am not aware that any actual demonstration of the working of the cause has ever been made. Since the trouble became known its origin has been assigned to the action of frost, but there was no tangible basis for the assumption until the matter was taken up and critically studied by Professor Burrill of Illinois. The results of his observations and the theoretical deductions from them were presented in a paper before the American Association for the Advancement of Science at the Ann Arbor meeting in 1885. After explaining frost cracks, and the phenomena attending the crystallization of liquids by frosts, he says—"The second form of injury—especially prevalent in apple trees—is believed to be due to the growth of ice crystals studding in a close or dense layer, the surface upon which they form. Such miniature forests of crystals can be found in green plants even after slight freezing, as well as in ripened wood in severely low temperatures." The process of crystal growth is further explained as follows: "In the trunks of trees the crystallizations begin in any part where there is proportionally most pure water. The very process of solidification causes, by the law of equal diffusion, a movement of water from adjoining parts, toward the point from which the first liquid (as such) is removed. Hence the ice crystals first formed constantly grow, attracting as it were the water from neighboring parts of the tissue. This growth of the crystals, associated as they occur in close layers, pushes asunder the normally connected tissues." The theory here given being based upon careful observations, and being in perfect accord with physical laws has been accepted as the true explanation of the trouble under discussion. It will be noted that the operation of the theory depends upon the presence of fluid sap, and that the greater the water content of the tree the more liable it is to

injury. It follows that the same conditions that protect against other frost injuries will protect against this. Fruit growers should therefore use every endeavor to thoroughly ripen the wood of the trees before winter sets in and thus reduce the liability to injury from frost to the minimum.

FUNGOUS DISEASES.

Leaf Blight or Rust of the Strawberry.—This is a cosmopolitan disease due to the parasitic fungus known as Sphærella fragariæ. While our climae conditions are in general unfavorable for the development of this disease, we do occasionally have periods during which it does injury. Moisture is necessary for the germination of the spores, and the fungus can spread to an injurious extent only during moist and warm weather. The month of June, 1895, was marked by prevailing high temperature and frequent showers, and during that time the disease did considerable damage to strawberry beds about Fort Collins. This past season the disease started under somewhat similar conditions toward the latter part of May, but showers becoming less frequent it did no serious damage.

All growers are familiar with the purple or red spots which mark the presence of this disease. These spots enlarge and become of a brown color; finally, by the growth of the spores beneath, the cuticle is ruptured and they then appear white at the center with a brownish ring outside. Affected leaves soon turn brown throughout and die.

This loss of foliage saps the vitality of the plant, and if the attack comes early in the season it prevents the development of a full crop of fruit. If the attack comes after the fruit has been harvested the plants are weakened so that the crop for the next year will amount to nothing, or at least be shortened, depending upon the severity of the attack. As the mycelial threads of the fungus are within the leaf tissues it is apparent that preventive, rather than curative measures, must be re-

sorted to. The fungus survives the winter within the leaf, both by pores and by its mycelium. It follows that the destruction of infested leaves in the fall is important as a means of holding the disease in check. The practice of mowing the old leaves after the fruit has been removed and then burning is not to be recommended because it sometimes results in injury. It is better to rake the leaves off the bed for burning and then by cultivation and the application of fertilizer induce a vigorous new growth preparatory to fruiting the next season.

The simplest and most effective way of controlling the disease is, however, by spraying with any of the standard fungicides adapted for application to foliage. The following have been successfully used. Hyposulphite of soda, one pound to ten gallons of water, applied every ten days. Modified "Eau celeste" made as follows—Dissolve one pound copper sulphate in two gallons of water; in another vessel dissolve one pound of sodium carbonate; mix these two solutions and when chemical action has ceased add one and one-half pints of ammonia. Dilute to twenty-five gallons. Ammoniacal copper carbonate made by dissolving three ounces copper carbonate in one quart of ammonia, and diluting to twenty-five gallons. Three or four applications of the copper solutions are usually sufficient.

ORANGE RUST OF BLACKBERRIES AND RASPBERRIES.

This disease has been reported from Arvada and other places near Denver, and has been present in Fort Collins for the past three years. It has not been particularly destructive, but the damage done is sufficient to warrant a word of caution. Eastern growers have in many places suffered severely from the disease, and it would be well to profit by their experience and use every effort to exterminate it. The cause of this disease is a true fungus (Cæoma nitens which has been known under various names since 1820.)

Its presence has been reported from nearly every state east

of the mountains; it is common in Canada, and is also known in Europe. Apparently it is confined in its work to plants of the one genus-Rubus, but has been observed on nearly every species of the genus. It works on wild as well as on cultivated plants, and appears to prefer some species to others. As between the dewberry and the blackberry it works most upon the dewberry; and between the black and red raspberries the blacks are more susceptible to attack. The disease also shows choice of varieties. Thus, the Kittatinny and the Erie blackberries seem much more susceptible to attack than do Snyder and Wilson.

The presence of the disease can be detected quite early in the spring in the tufted slender shoots which are produced, and in the glandular appearance given to some of the new leaves by an early and little understood spore form which the fungus produces. Later, about the 1st of June, the Aecidium or cluster cup spore formation may be looked for. The cluster cups first appear as small raised spots covering the under surface of the leaves; soon the skin is ruptured, the cups containing the spore masses protrude, and then we have that characteristic appearance which suggested the name orange rust.

This, the fruiting stage of the fungus, is conspicuous, and cannot fail to attract attention, but it is not all there is to the plant.

The vegetative portion consisting of very minute threads which ramify through the plant, and which must develop before spore formation can take place is not apparent to the naked eye; it gives no sign of its presence except by inducing the tufted growth of slender shoots.

It will readily be seen that this vegetative portion of the fungus is beyond the reach of any curative applications that might be made. It is secure within the tissues of the plant, and since it has been proved that the threads extend into the roots and are perennial, we are led to the conclusion that our only course is to completely destroy the infested plants. Spraying

has been recommended as a protection against the spreading of the fungus by the spores, but spraying will be unnecessary if the plants are carefully watched and the infested ones removed before the dissemination of spores begins.

ANTHRACNOSE OF THE RASPBERRY AND BLACKBERRY.

In 1896 canes of black-cap raspberry infested with this disease were sent us from near Denver. From the fact that nothing has been heard of the presence of the disease since, we regard this as an isolated case introduced, in all probability, on plants from some eastern nursery. The dryness of our climate is not favorable to the development of this disease and we apprehend no serious trouble from it; but as it is liable to appear at any time on introduced stock, it may be well to dwell briefly upon its characteristics. The cause of the disease is a fungus (Gloeosporium venetum) and Professor Burrill of Illinois is credited with publishing the first account of it in 1882 under the name of raspberry cane rust. The disease appears to be confined to the blackberry and black-cap raspberry. As with the orange rust the vegetative threads of the fungus ramify within the plant and are perennial. The first evidence of the presence of the fungus ascends and the spots appear at intervals even to the tips of the canes. The spores are formed about the centers of these spots and as thy push outward the bark is ruptured and curled back. The spots then appear grayish white with a purplish border. Often several spots coalesce, forming irregular patches. While the principal work of the fungus is on the canes, it is not wholly confined there, but may appear on the petioles and veins of the leaves. The nature of this fungus suggests the cutting out and burning of all canes seen to be affected. As a preventive measure it is recommended to spray, as soon as the canes are uncovered in the spring, with a solution of sulphate of iron, two pounds to five gallons of water, to be followed later, if the disease appears, by an application of the Bordeaux mixture.

HOW TO FIGHT THE CODLING MOTH

BY C. P. GILLETTE.

Many orchardists spray for the codling moth and still grow very wormy apples. The writer knows of an orchard near the experiment station that was sprayed with an arsenical mixture three times last summer and in which fully eighty per cent. of the fruit was wormy at the time of picking in September. Another orchard in the same neighborhood was sprayed twice and had less than two per cent. of wormy fruit at picking time. What made the difference? Why is it that one man sprays his orchard and has very little wormy fruit and his neighbor, who also sprays, has nearly all of his apples wormy? This is a question often asked and frequently difficult to answer satisfactorily. That a reason exists for the different results there can be no doubt. The object of this paper is to give the best directions that we can at present for the successful treatment of this insect. Perhaps it will explain to some why they have not met with better success in the past.

WHEN TO SPRAY.

No date can be fixed upon, yet spraying must be done at the right time if the best results are to be obtained. The right time is immediately after the blossoms fall before the calyces of the forming apples close. If there are belated blossoms on the trees after the great mass of bloom has fallen, do not wait for them if some of the calyces are closing. If the trees do not all bloom nearly together, spray the early blooming trees first and then in a few days spray the others. Repeat the application in one week, or, at the latest, ten days.

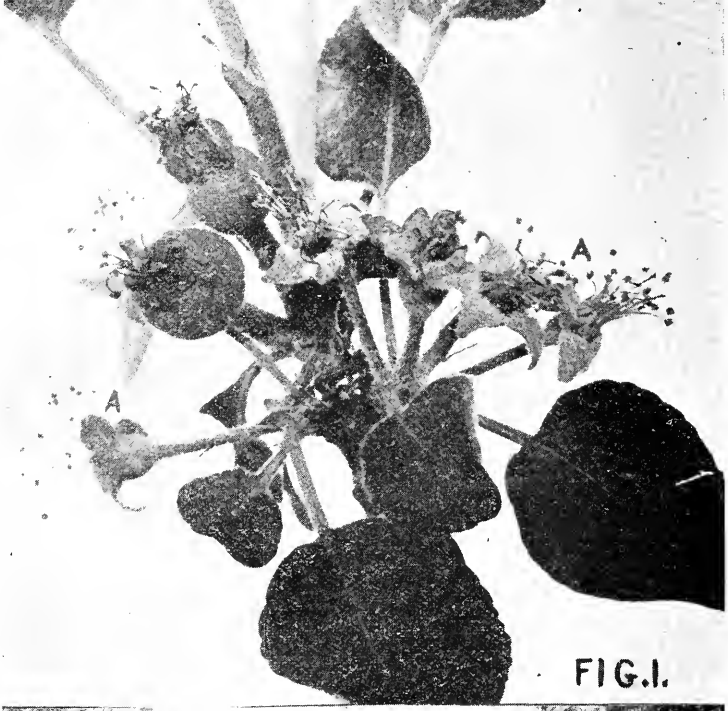


FIG. 1.

FIG. 2.

Fig. 1—Blossoms from which the petals have fallen, and still in good condition to recive the spray, also apples with the cayces closed.
Fig. 2.—Spraying scene in orchard of Mr. Bergher at Palisade, Colorado.

HOW TO SPRAY.

Be thorough with the work. It will take more time and material, but if spraying for this insect will pay at all it will pay best to do the work well. Use a nozzle that throws a medium fine spray, not a mist, and direct it so that the liquid will be thrown into every blossom or calyx. A misty spray will not carry as well into the blossoms. To make a thorough application it will be necessary to direct the spray from, at least, two sides of the tree, and if the tree is large, it will be almost necessary to apply from all four sides. In many orchards the trees are so closely set, so large and poorly pruned that it is impossible to make a thorough treatment of the destruction of the codling moth larvæ.

The one who directs the nozzle for the spraying will find it a great advantage to be elevated as high as the bed of a wagon box at least. If the trees are large, it will be well to use a step-ladder or a dry goods box in the wagon to elevate him still more.

NUMBER OF APPLICATIONS.

Orchardists differ widely in opinion as to the number of applications that should be made. Some, noticing that the worms are most abundant late in the summer, think that spraying should be continued throughout the season of growth and report excellent results from spraying five or six or more times. However, it is the opinion of those who have tested the matter most thoroughly at the various experiment stations of the country that it does not pay to spray more than twice, and if the two applications are properly made at the best time.

POISON TO USE.

Here again opinions differ. Probably Paris green is as effectual as any if well applied and if the liquid is kept thoroughly agitated during the spraying. Scheele's green would probably be as effectual as Paris green, is cheaper, and remains

in suspension in water better. London purple and arsenate of lime are readily kept in suspension in water but are slower in their action than the above mentioned poisons, and probably less effectual in their death-dealing power. They have the advantage of being very cheap. Arsenate of lead is kept in suspension without difficulty and is remarkable for its adhesive quality and its entire harmlessness to foliage unless used in great excess. It kills slowly and its value for the destruction of the codling moth has not been very definitely determined.

INSECTS CLASSIFIED

Insects with biting mouths always gnaw into and devour the tissue of the part of the plant on which they feed. Such insects would include all of the caterpillars, commonly known as worms, whether hairy or naked. All of the so-called slugs, grasshoppers, locusts, crickets, potato beetle, larvae of the leaf roller and the codling moth.

Insects with sucking mouths always cause the leaves to turn pale or brown in color, and include: Plant lice, scale lice, aphis, tirps, leaf hopper, squash bug, etc.

REMEDIES—FORMULAS

The following remedies and formulas are those adopted by the leading horticulturists and experiment station in Colorado for the extermination of pests, the prevention of the importation and spread of insects and diseases detrimental to the horticultural interests of Colorado.

REMEDY No. 0.

Arsenate of Lead or Disparene should be used in the proportion of three to six pounds to 100 gallons of water. The merits of this poison are—it will not injure foliage and it adheres better to the foliage than other poisons.

REMEDY No. 1.

Paris Green or London Purple: One pound; water 160 gallons; lime, two pounds.

First make paste of the poison in a small amount of water, then dilute to the proper proportions, by adding the fresh lime (slacked and strained). Apply in a fine spray as soon as blossoms have fallen, and again in one week. If heavy rains follow repeat the spraying. This remedy to kill biting insects. For peach and plum trees a mixture of one pound of the poison to 200 gallons of water may be used with the same amount of lime.

REMEDY No. 2.

To be used for same insects as No. 1. White arsenic one-quarter pound. Sal soda, 1 pound; lime, 4 pounds; water, 40 gallons.

First dissolve the arsenic and sal soda in hot water and boil

15 minutes, when ready for use. Slack 4 pounds fresh lime and add to 40 gallons of water, always strain through a fine wire screen to prevent clogging nozzle of spraying machine. Spray first time as soon as the bloom has fallen; second time 10 days later; third time between the 4th and 15th of July.

REMEDY No. 3.

Arsenic Bran Mash for grasshoppers.

Arsenic 1 pound; sugar 1 pound; bran 10 pounds.

Add to the ingredients water sufficient to make the mixture moist. And scatter in places where the grasshoppers are thickest. Care must be exercised as not to place where animals or fowls can get at it.

REMEDY No. 4.

Is valuable in destroying the currant worm, pear tree slug, rose slug, raspberry slug and the larvæ of saw flies.

White hellebore 1 ounce; water 3 gallons.

Apply as a spray late in the day. Air slacked lime or dust may be used instead of water in which case it can be dusted over foliage lightly from a cheese cloth sack.

REMEDY No. 5.

Is used for all fungus diseases.

Sulphate of copper 6 pounds; quick lime 4 pounds; water 22 gallons.

Dissolve the sulphate of copper in a gallon of hot water. Slack the lime in another gallon of water, and then add the milk of the lime slowly to the sulphate of copper while the latter is being constantly stirred; then add 20 gallons of water. Use a spray.

REMEDY No. 6.

Is especially used in destroying sucking insects, including plant bugs and plant feeding mites.

Kerosene 2 gallons; whale oil or hard soap 1 pound; soft water 28 gallons.

Dissolve the soap in 1 gallon of boiling water. (If the water is hard break with lye.) Heat the solution to boiling and (away from the fire) add 2 gallons of kerosene. Agitate freely for five minutes by pumping the liquid back upon itself with a force pump, or until the mixture assumes the consistency of cream. Add 27 gallons of water, then use as a spray. This liquid must never be used upon roots of trees or shrubs.

REMEDY No. 7.

Disinfectant to be used for boxes, barrels, etc.

Concentrated lye 1 pound; water 10 gallons.

Dissolve the lye in water and use boiling hot, keeping the material in one minute.

REMEDY No. 8.

Formula for fish oil soap. This is an effective remedy for scale insects, plant lice and sucking insects, which can be killed by contact.

Concertrated lye 3½ pounds; water 8 gallons; fish oil 1 gallon.

First dissolve the lye in boiling water, then add the oil and boil 2½ hours longer. This can be used as a substitute for whale oil soap.

REMEDY No. 9.

Winter rosin wash, is valuable in destroying scale insects in dry seasons.

Rosin 30 pounds; caustic soda (75%) 9 pounds; fish oil 4½ pints; water to make 100 gallons.

Boil the rosin, oil and soda until dissolved. Then boil for 3 hours during which time hot water should be added slowly, so as not to stop the boiling, until the whole is diluted to 50 gallons; the other 50 gallons may then be added cold.

REMEDY No. 10.

Lime, sulphur and salt winter wash. Used to destroy scale insects and eggs of brown mite and red spider.

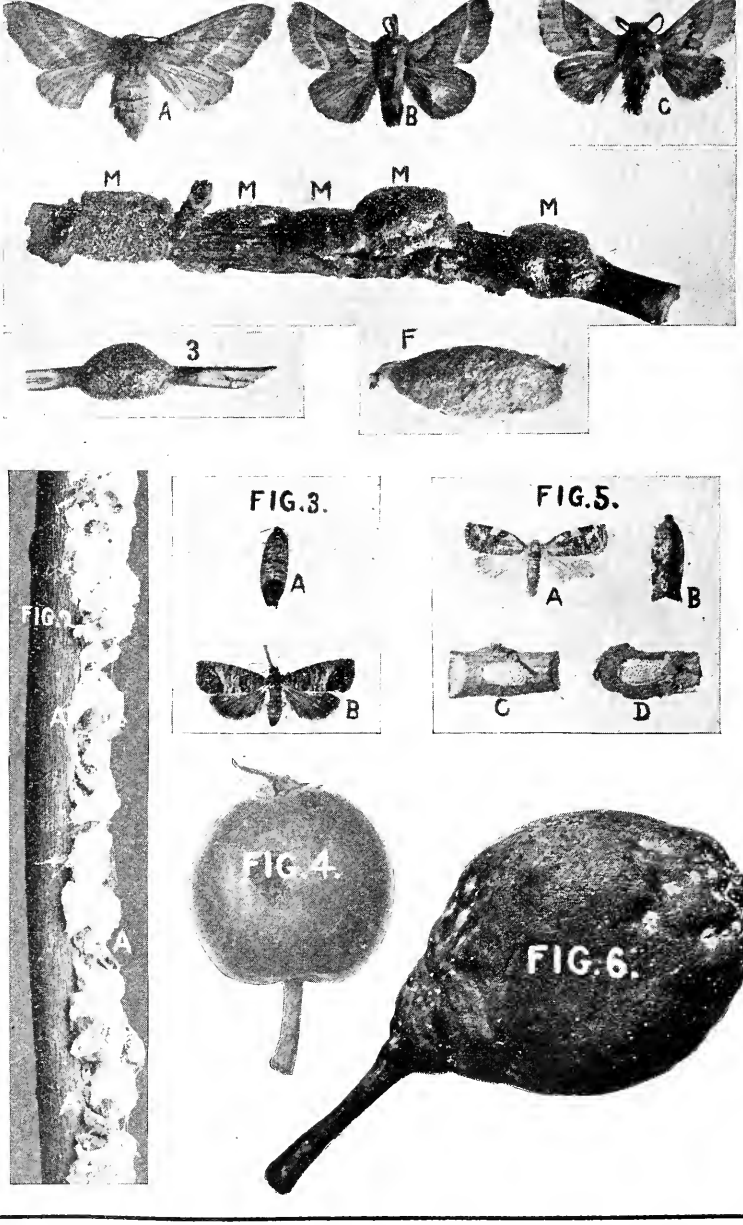


Fig. 1—Western tent caterpillar: A, female moth; B and C, males; D, apple twig with egg masses, (M) F cocoon; 3, egg mass of American tent caterpillar, life size. Fig. 2—Cottony maple scale: A, scales mostly hidden by secretions, life size. Fig. 3—Codling moth: A, wings closed; B, open, enlarged about one-fourth. Fig. 4—Apple showing white egg of codling moth under letter F, life size. Fig. 5—Fruit tree leaf roller: Letter A, moth with wings open; B, closed; C D egg patches hatched, all life size. Fig. 6—Pear with Howard scale, the young appear as minute white specks, life size.

Unslacked lime 50 pounds; sulphur 25 pounds; stock salt 18 pounds; water to make 100 gallons.

Put the sulphur and one-half the lime in 25 gallons of water and boil until the sulphur is dissolved. Mix the remaining lime with the salt and slack with water, then add to sulphur mixture and boil for another hour, when the whole can be diluted to 100 gallons with water. (Strain before using.)

REMEDY No. 11.

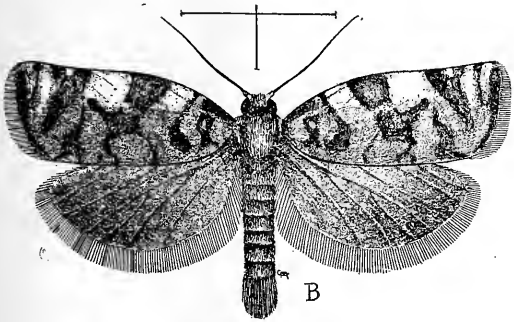
Whale oil soap. This substance stands close to kerosene emulsion in importance as a destroyer of soft bodied insects. It may be used for dipping the roots of nursery stock.

Whale oil soap 1 pound; water 8 gallons.

As a winter wash it is sometimes used as strong as 2 pounds in a gallon of water for the destruction of San Jose scale. Putnam and other scales. A pound to 2 gallons of water destroys the eggs of plant lice or of the Brown Mite.

APPLE TREE ENEMIES.

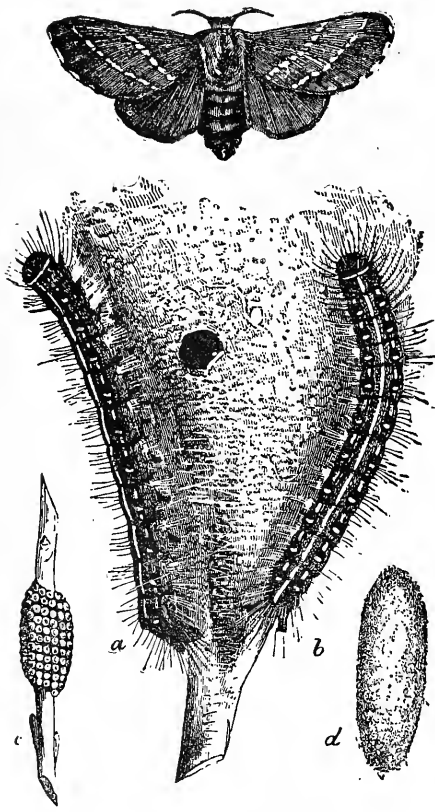
The Codling Moth.—Use remedy No. 1 or No. 2. First application as soon as blossoms fall. Second application one week later.



Apple Leaf Roller.

Apple Leaf Roller.—Use remedy No. 1 or No. 2. Apply the spray as soon as leaves appear and repeat once a week as long as worm lasts.

Apple flea Beetle.—A small metallic green beetle about 1/8 of an inch in length that eats holes in the leaves and jumps and takes wings quickly when disturbed . Use remedy No. 1 or No. 2.



Tent Caterpillar—Showing tent, egg, moth and larvæ.

Tent Caterpillar.—The tent caterpillar is a native of Colorado. The eggs appear in greyish white rings around the twigs and limbs of trees. They hatch out about the time the leaves appear in the spring, and form little webs on the end of the twigs. When they mature they leave the web and form colonies, and during the day stay on the trunk of the trees. By spraying with warm soap suds it kills them instantly.

Fall Web Worm.—A yellowish or brownish caterpillar with a black head that forms a loose web or tent in a great variety of trees, appearing about the first of July and continuing through the summer. The larvæ is covered rather sparsely with long hairs that are whitish or yellowish in color, with occasional black ones. When the webs are small, cut out and burn. If the webs have become large, inclosing many branches of the tree, burn the worms with a torch.

Apple Flea Beetle.—During the winter and early spring, there are small shining black specks in rough places on the bark and about the buds, or distributed promiscuously over the surface of the small limbs. Usually abundant where there are num-

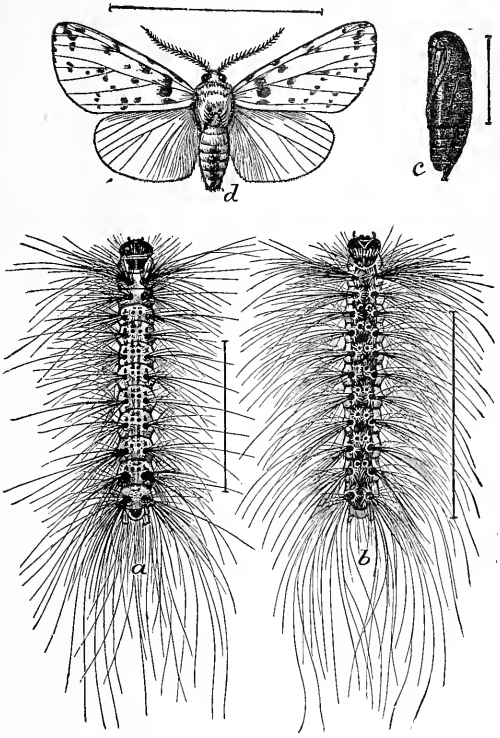
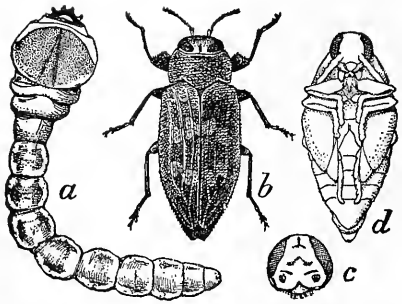


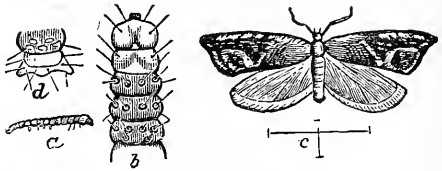
Fig. 1.—Fall webworm—A and B, Caterpillars; C, Chrysalis; D, Moth.

erous fine plant hairs, making a felty covering to which the eggs are easily attached. The best time for treatment is when the trees are dormant. Any time after the leaves fall or before the buds open. Use whale oil soap in the proportion of 1 pound to 2 gallons of water. After the leaves are out use No. 6.



Flat Headed Apple Tree Borer.—Fig. A, flat headed larvæ; B, mature beetle; C, head of mature beetle; D, Pupa; all twice natural size.

Flat Headed Borer.—First protect the trees from sun scald and other injuries. In winter or spring the borer can be grubbed out with a sharp knife and killed. The borer can be kept in check by washing the trees with No. 9 or No. 10 about the time the eggs are laid, and wet the ground to de-

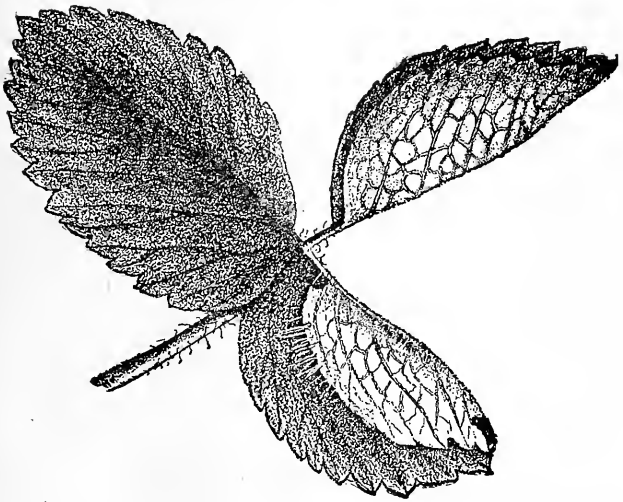


Strawberry Leaf Roller—A, Larvæ, natural size; B, head end of larvæ enlarged; C, moth, twice natural size; D, tail end of larvæ, enlarged.

stroy the hopper. Avoid spraying while the vines are in bloom. The Grape Leaf Hopper also appears on currant and gooseberry bushes and Virginia Creeper.

Strawberry Leaf Roller.—After the berries are picked mow the vines and mulch with a light covering of straw or other rubbish that will burn easy, then burn when there is a brisk wind. When the rubbish is burned off irrigate immediately. If worms appear late, spray with No. 1 or No. 2.

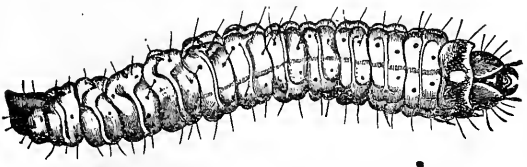
The Imported Currant Borer.—The moth begins to fly in June, and are usually caught in a net at egg laying time, and destroyed. Much can be done in this way to lessen the number of eggs laid and hence, the number of larvæ to bore in the currant stems. By cutting out all the infested stems in the spring the injuries for the following year will be lessened.



Strawberry Leaves Showing Their Appearance After Being Folded by The Roller.

SHADE TREE ENEMIES.

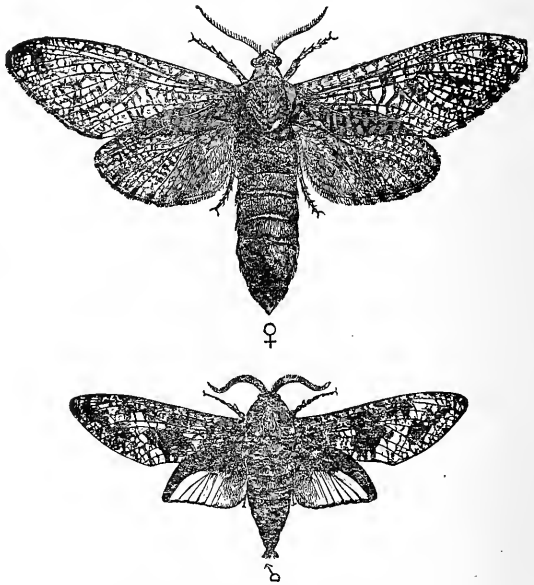
Cotton Wood Borer.—This insect is also known as the Oak Carpenter worm. The larvæ when fully grown is nearly 3 inches long with a shining black head it cuts large holes in the trunks of the trees. The castings of the borer are pushed out on the surface and the tree bleeds as a result of the wounds made to the surface. The sap runs down on the surface and sours, making a breeding place for maggots for certain flies. With a stout wire many of the borers can be killed in their burrows. Avoid scarring the trees as much as possible, as borers usually enter at such places.



Cottonwood Borer, Much Enlarged.

The cottonwood is also attacked by plant lice, fall web worm and Putnam scale. Use remedies as hereinbefore prescribed for same.

The Box Elder Leaf Roller.—This insect is a close relative to the fruit tree leaf roller and seems to confine its attacks in this state to the box elder alone. The eggs are laid in the surface of the rough bark and are covered with the scales from the underside of the abdomen of the female, which are placed like shingles on a roof. Use remedy No. 1 or No. 2.



Moth of Cottonwood Borer, Much Enlarged.

The Ash Gall Louse.—Greenish plant lice curling the leaves of white ash. The lice usually accumulate on the leaves at the end of the limb. The leaves curl and become so swollen and loaded with lice that the limb will often be bent down with the weight. As soon as the leaves at the end of the limb begin to

Showing the Effects of the Elm Leaf Cluster Louse.

curl, cut the limb off far enough back to include all the infested leaves and burn them.

The Elm Leaf Cluster Louse.—Trim out all the clusters and burn as soon as they appear. To prevent their appearance another season, spray the trees during the winter with remedy No. 9 or No. 10.

The Cottony Maple Scale.—A yellowish or brownish scale on the twigs of soft maple. During the fall and winter and early spring the scales are quite flat. During May convex, and finally a mass of white cottony thread appears at one end raising the end of the scale from the limb to an angle of about 40 or even more. In this cottony mass an enormous number of minute yellowish eggs are deposited. Often as many as 2,000 to the single scale. A thorough spraying with remedy No. 6 will kill the young lice.

The Pine Leaf Scale.—White elongated scales appear on leaves of pine and spruce trees. And beneath the scales, in the spring, will be found a mass of purple eggs, causing the leaves to fall. Use 1 pound whale oil soap to 4 gallons of water as a spray, after the young lice have hatched, which will be about June 1st.

Caution Regarding Blight.—The orchard should be examined in the fall or early winter, cutting off every branch showing any signs of holdover blight, the germs of which remain during winter in partly dormant condition. In cutting out blighted portions there is one precaution that should always be observed, and that is the sterilization of the knife. All branches cut off must be burned.

Sterilization Mixture.—Carbolic acid 2¼ ounces; water 1 quart. Agitate well and dip knife blade into after cutting each branch.

PLANT LICE AND THEIR REMEDIES

BY S. ARTHUR JOHNSON.

The abundance of plant lice during the past three years has led to a number of experiments at the station which have covered a wide range of insects and insecticides. The results indicate that proper methods will keep these pests under control.

LIFE HISTORY.

Plant lice are tiny insects usually rounded in form and provided with two little tubes which extend upward and backward from the abdomen. Lice live upon the juices of plants by thrusting their bills through the epidermis of the tender twigs or leaves. The first brood in the spring is produced from eggs which were laid the previous fall. The other generations, except the last, are females born alive, and these young begin immediately to suck juices and soon bear other young, the number of which may result in a single season from the hatching of one egg is almost incredible. The first generations are wingless and live not far from the place where the eggs are hatched. In time, however, winged individuals appear. These fly to new feeding grounds and are the chief source of distribution. Most lice are green and escape notice, but some are made conspicuous by their colors. The last brood in the fall lay eggs. These may be seen after the leaves have fallen as tiny black oblong objects on the limbs and about the buds. An abundance of these indicates that watchfulness will be needed the following spring.

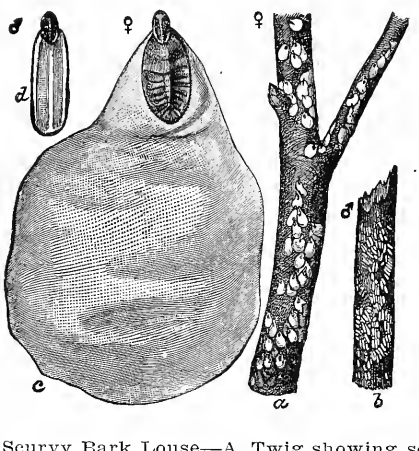
THEIR ENEMIES.

Generally plant lice are kept under control by their enemies, chief of which are the lady-birds and syrphus flies. Adult lady-

birds may usually be recognized as oval red beetles spotted with black. The larvæ are oblong, rough and commonly mottled red and black. They have three pairs of legs and a distinct head. The eggs are yellow and laid in patches where lice are abundant. The syrphus fly larvæ are smooth, green or greenish white and without distinct legs and head. The eggs are white, oblong bodies which are laid singly on the leaves of infested plants. Where the enemies are abundant they will destroy the lice and spraying is unnecessary.

INSECTICIDES.

From the manner of their feeding it is impossible to kill plant lice with poisons. It is necessary to employ some substance which will kill by contact and to apply it very thoroughly, for every insect which escapes the application remains to repopulate the food plant. These precautions are valuable: 1. Spray upward with force so as to wet the under side of the leaves. 2. Spray before the winged forms appear to prevent distribution. Among the best insecticides are:

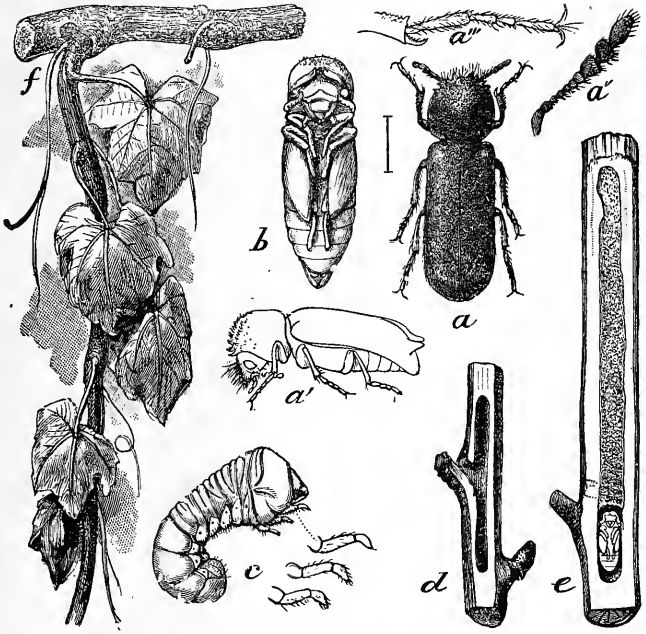


Scurvy Bark Louse—A, Twig showing scales of female; B, Twig showing scales of male louse; C, Scale of female greatly enlarged; D, scale of male greatly enlarged.

The presence of this insect is indicated by very small white scales upon the trunk or limbs of the trees, sometimes entirely covering the bark; and appear like a covering of scurf or dandruff. The use of No. 9 or No. 10 while the trees are dormant will probably kill the scales. After the leaves are out, if the lice appear, use No. 6 the last of May and

again about the 10th of June. The same remedy may be used to eradicate the oyster shell bark louse and the Putnam scale.

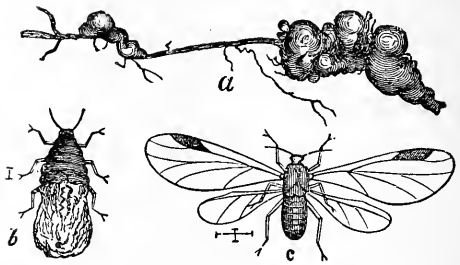
Whale-oil Soap.—This must be dissolved in boiling water, after which it is diluted in the proportion of one pound of soap to from six to twelve gallons of water.



Apple Twig Borer—A, beetle, dorsal view; A', beetle, side view; B, pupa from beneath; C, grub, side view; D, apple twig showing burrow; E, burrow in tamerisk, with pupa at bottom; F, stem of grape, showing burrow; all enlarged except stems showing burrows.

Apple Twig Borer.—A cylindrical mahagony colored beetle, about 1-3 of an inch in length, boring holes in twigs of apples, cherry, pear, osage orange and other trees, also grape vines. The burrow starting just above the bud and extending downward. The remedy is to cut out the stems so infested and burn them.

Woolly Aphis.—As soon as the lice appear in the trunk of the trees in the spring before they get into the branches, apply

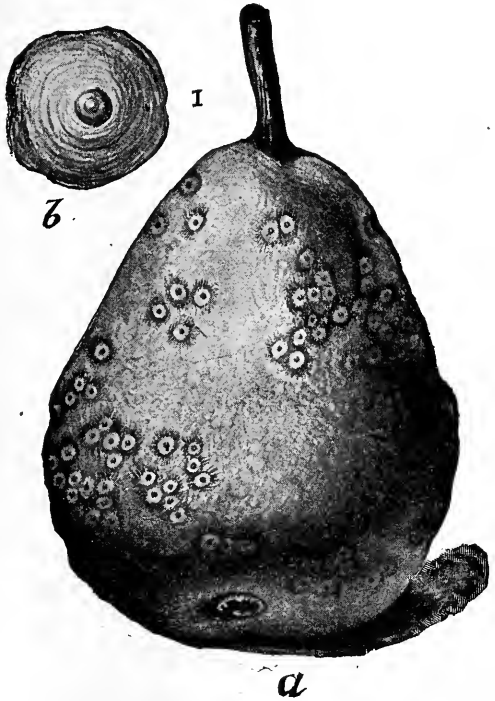


Woolly Aphis, Root Form.—A, showing swellings caused by lice; B, wingless louse, showing woolly secretions; C, winged louse.

kerosene oil with a brush or swab. By repeating the operation a few times they may be kept largely from the tops of the trees. One form of this insect is found on the roots of the trees and produce wart-like swellings. Another form appears on the trunk and limbs, and is usually densely covered with woolly excretion. The

Showing Woolly Aphis on Branch

best remedy for the root form is tobacco dust worked into the ground to the amount of 3 to 6 pounds about the crown of the tree and then wet with water. In the hands of one who has had experience, carbon bisulphide, may be used by injecting it into the ground about the crown of the tree. If the lice spread over the top of the trees, they may be treated with remedy No. 6 or No. 11. It is necessary to apply with a great deal of force, so as to wet through the wool which protects the lice from any light spray. When the lice are found on the roots of nursery stock, it is advisible to dip the roots in No. 11, or to fumigate with hydrocyanic acid gas. The latter is the best treatment.

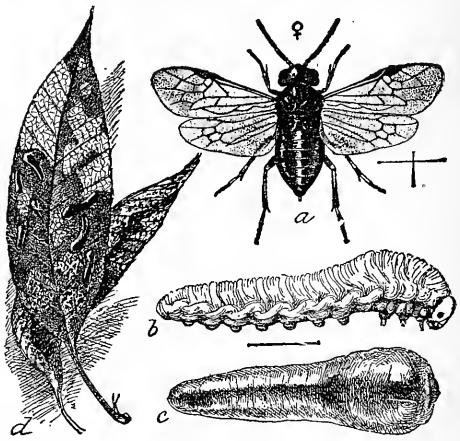


Showing San Jose scale on pear. Fig. 2—Scale enlarged

Bands on trees for Codling Moth.—Wrap around the trunk of tree one or more feet from the ground, three thicknesses of burlap six inches wide. Put in one tack where the burlap joins. The bands should be in place by June 10th, and examined every three or four days, and the worms taken out and killed, until the apples are gathered. If bands are put on to trees, as above described, they must be attended to, or the bands will be of service to the worms by forming a place of security from birds, etc. Also folded pieces of burlap, in crotches of the trees, will catch many worms.

PEAR TREE ENEMIES.

For Red Spider or Brown Mite.—To kill eggs while the trees are dormant in winter, use remedy No. 9 or No. 10, or whale oil soap, 1 pound to 2 gallons of water. For spraying after the leaves are out use No. 6. These insects also attack cherry, apple and plum trees, rose bushes and sweet peas.



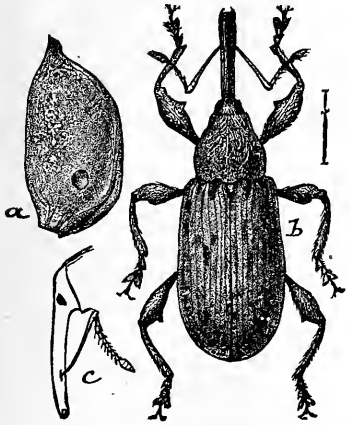
Pear Tree Slug.—A, adult fly; B, larvæ or slug with slimy covering removed; C, same as preceding, in natural condition; D, leaves showing slugs and their injuries.

Pear Tree Slug.—For pear tree slugs use remedy No. 1 or No. 4. Plum and cherry trees arse also infested by these slugs.

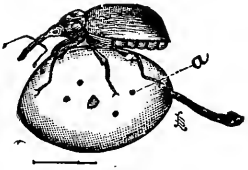
For Pear Leaf Blister.—This disease in indicated by small black spots appearing on pear leaves, sometimes so numerous as to run together and involve a great portion of the leaf before turning black the spots are green, like the rest of the leaf. The parasite may be killed during the winter or early spring, when the trees are dormant, by a spray of kerosene emulsion in which the kerosene is 1-5 of the mixture. The parasite spends the winter under bud scales upon the trees.

PLUM TREE ENEMIES.

For Green Aphis apply No. 6 or No. 11. This does no harm to the birds which prey upon all plant lice.



Plum Gouger—A, plum pit, showing holes for exit of gouger; B, gouger; C, side view of head of gouger, showing beak and antenna.



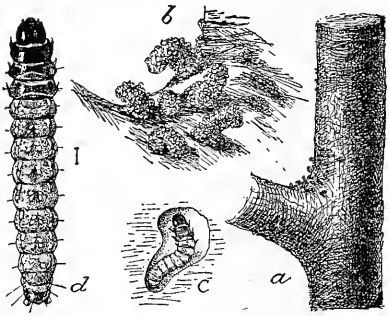
Showing Plum Gouger at Work.

For Plum Gouger.—Many of these insects can be caught by jarring the trees as soon as they are in bloom, placing a sheet under the trees to catch the insects. Collect and destroy all fruit stung before the plums ripen.

Plum Leaf Nail Gale.—The leaves of the American varieties of the plum are sometimes injured by the production of a large number of slender tubular projections standing out from the

upper surfaces. Inside each gale are large numbers of very small spider-like insects or mites. Nothing can be done of much value while the trees are in leaf. Fallen leaves should be destroyed as much as possible by fire and the trees sprayed with No. 9 or No. 10.

Plum Cucolio.—Jarring as for the plum gouger is the best of arsenical sprays.



Peach Twig Borer—A, twig of peach showing little masses of chewed bark above the larval burrows; B, the same enlarged; C, larvæ in winter, burrow enlarged; D, hybernating larvæ, greatly enlarged.

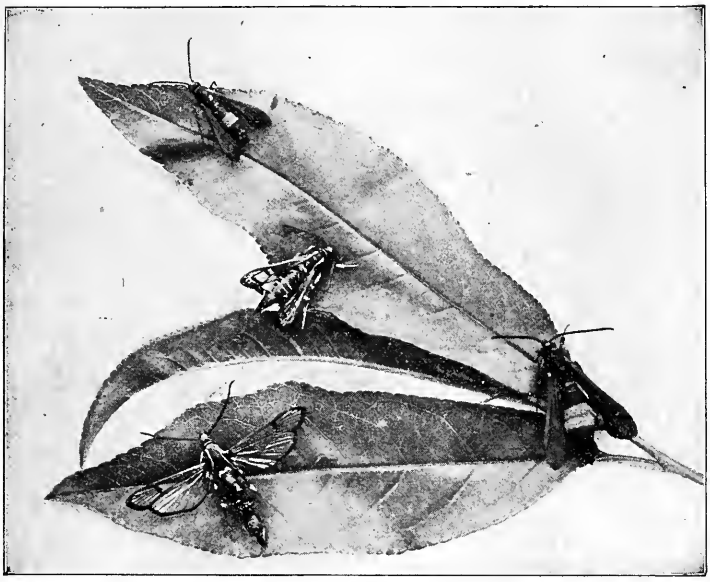
Peach Borer. —A yellowish white larvæ or borer working beneath the bark at the crown of the tree and down on the roots, causing the exhalation of a gummy substance. The eggs are laid about the crown of the tree by a small moth with steel blue wings that flies in the bright sunshine and resembles a wasp in appearance.

PEACH TREE ENEMIES.

Peach Borer.—A yellowish white larvæ or borer working beneath the bark at the crown of the tree and down on the roots, causing the exhalation of a gummy substance. The eggs are laid about the crown of the tree by a small moth with steel blue wings that flies in the bright sunshine and resembles a wasp in appearance.

Cut out the borer with a knife. This should be done early remedy for this insect. Some benefit can be derived from the use sect in check. A little dirt should be brushed away from the crown of the tree to discover any burrows that may be apparent at the surface.

Other insects that may be found attacking the peach are Plum Curcula, San Jose scale, Red Spider, Brown mite and plant

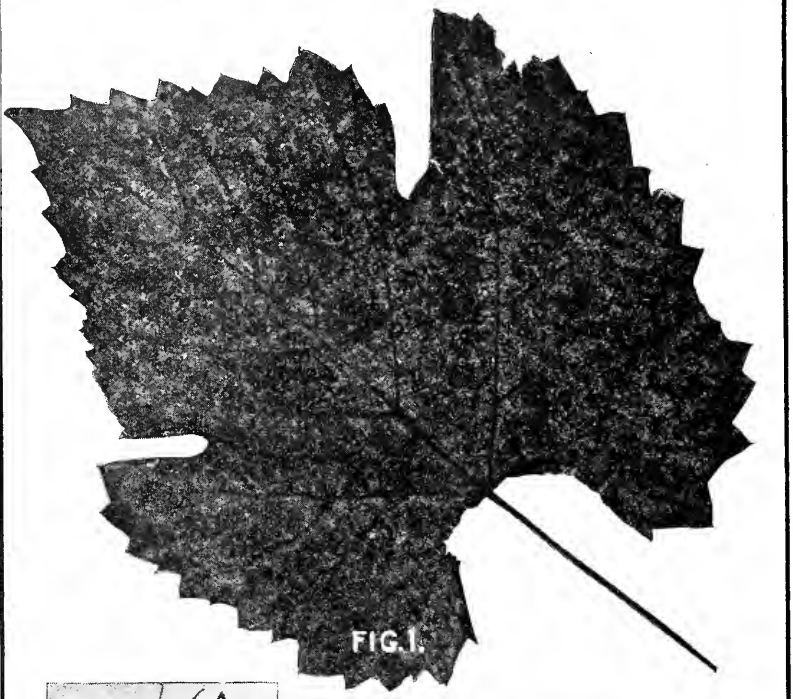


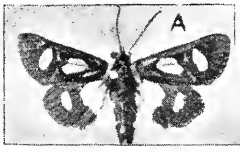
Moths of Peach Borer.

Peach Twig and Borer—A, young shoot wilting from attack of borer; B, adult larvæ, enlarged; C, chrysalis, enlarged; D, tail end of chrysalis, showing hook.

lice. The same remedies hereinbefore mentioned for the destruction can be used.

Peach Twig Borer.—Remedy No. 10 is the best thing so far tried. Use just before the buds begin to swell in the spring. After the trees have bloomed and the peaches formed, apply bands to trees the same as described for codling moth. Another remedy recommended by Farmers' Bulletin No. 80, United States Department of Agriculture,





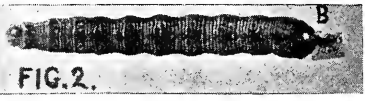


FIG.2.

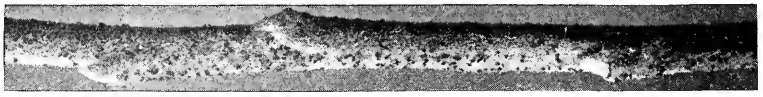


Fig. 1—Grape leaf, showing bleached appearance due to grape hopper.
Fig. 2—Eight spotted forester—A, moth; B, larvæ, nearly life size.

is kerosene emulsion, and clipping affected limbs off and burning them.

INSECT ENEMIES OF SMALL FRUITS.

The Western Currant and Gooseberry Span Worm.—Use remedy No. 6, or insect powder, as in case of plant lice.

Grape Leaf Hopper—Spray with remedy No. 6 before sunrise. Apply with force so as to knock the insects off of the vines

Tobacco Stem Decoction.—Tobacco stems or dust may be purchased from cigar manufacturers at a very reasonable price. They should be put in cold water, heated to boiling point and boiled for half or three-quarters of an hour. The decoction is then diluted to make from two to five gallons of spray for each pounds of stems. The preparation should be used before it becomes sour or stale.

Kerosene Emulsion.—This may be used in proportion of from one gallon of oil to fifteen of water, to one to twenty-five.

Whale-oil soap and kerosene emulsion are liable to injure the foliage when used in strong solutions. Probably the tobacco preparations are safest where these are needed.

COMMON PLANT LICE.

Green Apple Louse.—This is rather difficult to kill. It may be treated with whale oil soap in the proportion of one pound of soap to six gallons of water; tobacco stem decoction one pound to three gallons; or kerosene emulsion one to fifteen. It is best to spray before the lice have caused the leaves to roll or early in the spring when the lice have just hatched.

Green Plum Louse.—Use tobacco stem decoction, one pound to four gallons, or tobacco soap, one pound to twelve gallons.

Black Cherry Louse.—It is conspicuous for its color. It is rather hard to kill. Apply the stronger strengths of any of the insecticides named above.

Snowball Louse.—Lives in the young buds and curls the leaves in such a way that it cannot be easily reached. Drench the stem and opening buds in the spring with whale-oil soap, one pound to eight gallons.

THE APPLICATION OF INSECTICIDES

BY C. P. GILLETTE.

In the Dry Way.—The upper surface of the leaves of all low plants can be easily treated with a dry insecticide by dusting it upon them through a cheesecloth, or other thin muslin sack, held in the hand. There are also various appliances upon the market for the distribution of powders. One of these that is very convenient for filling the air of a room with dust to kill flies, or for the application of powders to low herbage, is shown in Fig. 15. It can be had of Thomas Woodason, 415 East Cambria street, Philadelphia, Pa.

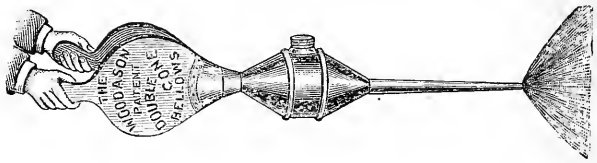


Fig. 15—Dust-sprayer.

The Hillis Dust Sprayer Company, of St. Louis, Mo., manufacture a "dust sprayer" large enough to distribute dry insecticide through trees of the size of an ordinary apple tree.

In the Wet Way.—There are so many manufacturers of spray pumps and nozzles of all descriptions that it is impossible to point out any make as the best. The illustrations here given are for the purpose of giving the reader an idea of the kind of a pump that will be needed for his work. Each must be his own judge as to the quality and price of the pumps offered him..

Fig. 16 is an illustration of the "Faultless Sprayer," manufactured by F. E. Myers & Bro., Ashland, Ohio. It is inexpen-

sive and will answer well where only a few small plants are to be treated.

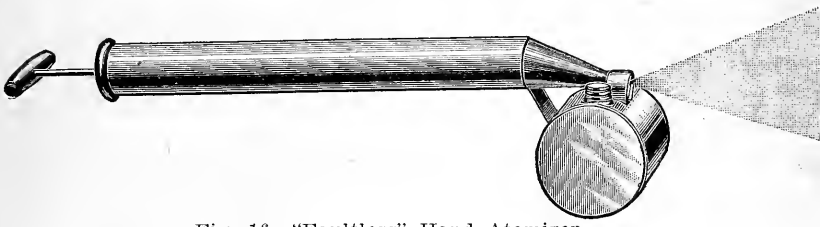


Fig. 16—"Faultless" Hand Atomizer.

Fig. 17 shows a form of atomizer, having a similar use, also sold by Woodason of Philadelphia.

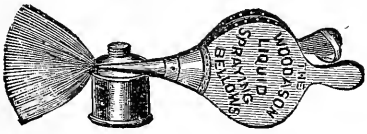


Fig. 17—Bellows Atomizer.

PUMPS.

Pumps with metal valves should be obtained for the application of insecticides or fungicides in liquid form, as the materials used harden or decompose leather valves so that they last but a short time. If the pump is to be used with a tank or barrel it is also important to have some kind of attachment that will keep the liquid agitated so the materials in suspension will not settle. A common error is to purchase a pump of too small capacity, because it is cheaper. A smaller, cheaper pump usually means less accomplished in a day with the same help, but with a greater ex-

Fig. 18–Bucket Pump.

penditure of energy. And then, it is often important to complete the spraying in as short a time as possible after it is begun. To do this, a pump of large capacity with two or more leads of hose is necessary. The hose to which the nozzles are attached should be as light as possible and still have the resuisite strength—a hose of good quality with heavy wall, but small caliber. Fig. 18 illustrates a form of bucket pump manufactured by The Deming Company, Salem, Ohio. Bucket pumps are sold by different dealers at prices ranging between about $2.00 and $8.00 in price. They are suitable for use among vegetables, shrubbery and all low plants, but should not be purchased for orchard work if one has more

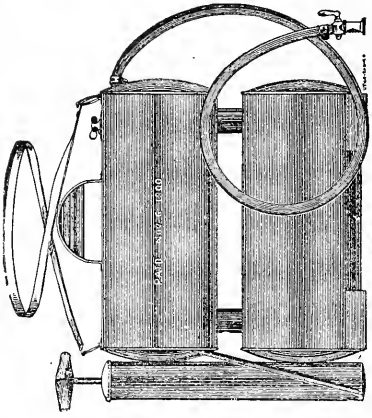


Fig. 20—Another Form of Air-Pressure Pump.

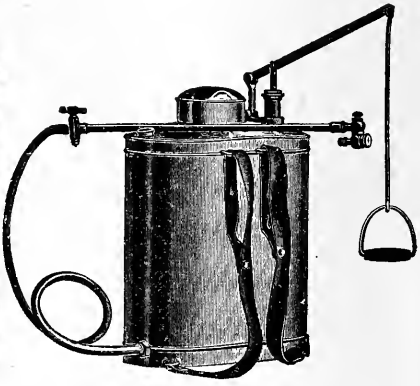


Fig. 21—Knapsack Sprayer.

than a very few trees to treat. In the small sprayer shown at Fig. 19 the liquid is forced up by means of air pressure. Such

Fig. 19—Leggett's Air-Pressure Pump.

a pump is often convenient when a person is compelled to do his spraying alone. This sprayer also has an oil attachment, so that water and kerosene may be applied mixed without the trou-

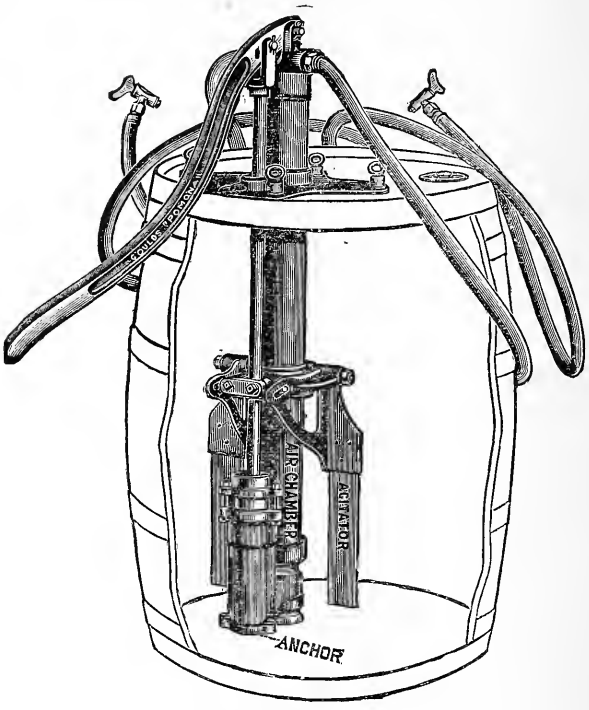


Fig 22—Barrel Pump.

ble of making an emulsion. This pump is manufactured by Leggett & Brother, New York City.

Fig. 20 shows a form of air-pressure sprayer sold by the North Jersey Nurseries, Springfield, New Jersey.

Many prefer some form of the knapsack sprayer for the treatment of low plants. At Fig. 21 is shown one of these spray-

ers as sold by William Stahl, Quincy, Illinois. Knapsack sprayers are also made with an oil tank attached so as to spray kerosene, or petroleum, in a mechanical mixture along with water, so as to do away with the need of making an emulsion.

For the treatment of small orchards a barrel pump is generally used. One of the best of these is Gould's "Pomona" spray pump shown in Fig. 22. The pump carries two leads of hose and has a patent agitating arrangement within the barrel. It is sold by The Gould Manufacturing Company, Seneca Falls, New York.

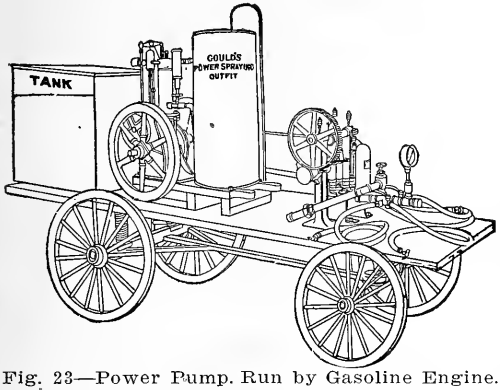


Fig. 23—Power Pump. Run by Gasoline Engine.

Where a large amount of orchard spraying is to be done larger pumps and tanks should be used. Fig. 23 shows a gasoline power sprayer attached to a large wagon tank. Such sprayers will easily run four leads of hose and keep up a high pressure. Without a good pressure it is impossible to throw a fine and forcible spray. The power sprayer here shown is also manufactured by the Gould Manufacturing Company. There are many other companies manufacturing spraying apparatus. Their advertisements will be found in agricultural papers. If anyone is thinking of purchasing an expensive spraying outfit he should obtain catalogues and prices from several manufacturers or dealers and then purchase where he thinks he can do best.

HOW TO SPRAY.

The first requisite for a good job of spraying is a pump that will give plenty of pressure in the hose. Then, if one has a good spraying nozzle and a liquid that is free from solid particles of a

size to clog the sprayer, there will be no difficulty in getting a good spray. A very fine spray is most economical of material and, for an even and thorough distribution, is best. Care should be taken, also, not to continue the spraying until the little drops

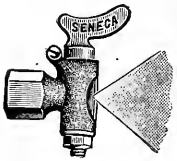


Fig. 24—Seneca Nozzle.

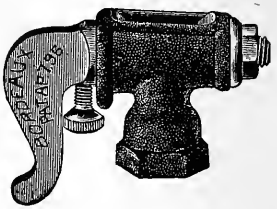


Fig. 25—Bordeaux Nozzle.

that collect on the foliage unite and run off, carrying the poison with them. In some cases, however, as when spraying the first and second times for the codling moth, the writer prefers a rather coarse spray and to continue until the calyces of the forming fruits have all been thoroughly drenched without regard as to how much the liquid is dripping from the foliage. The medium coarse spray is preferred for this work, because the larger

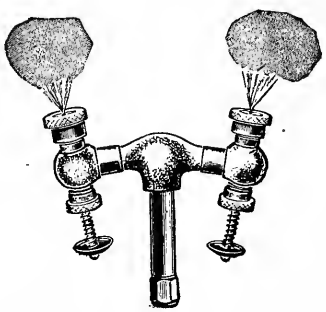


Fig. 27—A Battery of two Vermorel Nozzles.

Fig. 26—Single Vermorel Nozzle.

drops carry better into the blossoms, or calyces, of the apples.

The "Seneca" nozzle sold by the Gould Manufacturing Company and shown at Fig. 24 throws a good coarse spray. The "Bordeaux" nozzle shown at Fig. 25 and sold by The Deming

Company is one of the best nozzles for either coarse or medium fine spray. For a very fine, misty spray I know no nozzle that equals the "Vermorel." This nozzle is mounted singly, as shown in Fig. 26, or in batteries of two, three or four nozzles combined. A battery of two nozzles is shown at Fig. 27. Figs. 26 and 27 are from the catalogue issued by the Gould Manufacturing Company.

GRASSHOPPERS—THEIR HABITS AND REMEDIES

BY C. P. GILLETTE.

The several injurious species of grasshoppers occurring in Colorado undoubtedly occasion heavier annual loss than any other single insect pest, not excepting the codling moth. It is the object of this brief paper to give the most important information as to the habits of these destructive insects and the remedies that may be used against them.

LIFE HABITS.

All our specially destructive grasshoppers spend the winter in the egg state in the ground. The eggs are from about three to four-sixteenths of an inch in length, cylindrical in form, yellowish white to yellowish brown in color and are deposited in compact masses of from about twenty to as many as seventy-five together. The females dig small holes to the depth of an inch or a little more with the stout ovipositor at the tip of the abdomen. The abdomen is then thrust in as far as it will reach and a gluey material is exuded and smeared over the inner wall of the little cavity, making it firm. Then the egg mass is deposited and it is also covered with the gluey material which soon hardens and protects the eggs from excessive moisture and from being easily crushed. Egg-laying of some of the species begins about the first of August and continues until hard freezing late in the fall kills all the old females. As a rule, a single female deposits two packets of eggs.

The places most chosen by the females for the purpose of egg-laying are ditch-banks, the borders of fields and road sides. The egg packets are also most often found about the roots of plants, as alfalfa, clover or weeds. If the eggs are at all abundant, a little digging about such plants where the grasshoppers

were numerous in the fall will usually reveal them.

The eggs begin to hatch about as soon as vegetation starts in the spring and continue for several weeks, but the eggs of a single pod all hatch together. The young hoppers begin at once to feed upon such tender growing plants as are at hand, various common weeds entering largely into their diet. When young and wingless, they are inclined to remain rather close to their place of hatching, but as they grow, they scatter about more and may become quite evenly distributed through a large field. The tendency to remain together in large flocks is more or less marked, however, and particularly is this noticed late in the afternoon when they congregate along the borders of the fields and upon the fences to spend the night. So marked is this habit that where are grasshoppers abundant it is a common sight to see a strip from ten to thirty feet or more wide about the borders of an alfalfa field that is almost denuded of vegetation. Sometimes the grasshoppers do great damage by ascending trees and eating fruit and foliage and gnawing the tender bark from the twigs. Such injuries usually occur alongside an alfalfa or pasture field from which the grasshoppers have migrated.

REMEDIES.

There are many remedies that may be used to advantage against grasshoppers. Which is best to use in a given case depends upon circumstances. It may be best often to use a combination of remedial or preventive measures.

DESTRUCTION OF THE EGGS.

The best of all artificial remedies, where it can be used, is plowing deeply late in the fall or early in the spring, all the ground where the eggs are abundant. Even the young hoppers, when very small, may be turned under quite successfully in this manner and destroyed.

Where plowing can not be resorted to, a thorough harrowing, especially with a disk harrow, will do much to destroy the

eggs. Some will be crushed, others will be eaten by birds and still others will succumb to the freezing and thawing and drying when separated from the egg-mass. These remedies must be applied before the young hoppers hatch.

DESTRUCTION OF THE GRASSHOPPERS.

Burning.—When the grasshoppers are quite small and travel slowly, they may be killed along ditch banks and in other places where they are abundant by covering the ground with straw and then burning it.

Poisoning.—Young hoppers may also be poisoned in large numbers by thoroughly spraying the young weeds and other vegetation on the waste land where they are hatching in large numbers with any of the arsenical poisons, as Paris green, arsenite of lime, arsenate of lead, etc. The poisons should be used rather strong. Later, when the hoppers get into the crops, they may be poisoned quite successfully by the use of arsenic-bran mash. Mix a pound of Paris green or white arsenic with about twenty pounds of bran, moisten enough with water so that the particles will adhere together in a crumbly mass, and then sow broadcast where the hoppers are most abundant. Do not use this where chickens feed.

Bandages.—To keep grasshoppers out of trees, bandage the trunks with cotton batting or printer's ink or axle grease. If either of the last two named substances is used do not put it upon the bark of the tree, but upon heavy paper which is first wrapped about the trunk. If the hoppers jump or fly into the trees, using poisonous sprays or driving with whips will have to be resorted to.

Hopper-Dozers.—For open fields, the hopper-dozers, or catchers, are probably our best remedy after the grasshoppers have hatched. A cheap and simple form of hopper-dozer, which is probably as effectual as any. The pan is made of sheet iron and the back is extended by means of upright stakes and a strip of muslin. In the pan is placed a quantity of

kerosene or crude petroleum, or a small amount of water with oil upon the surface and the pan or dozer is then drawn over the field by hand or by means of a couple of horses kept well apart so as to collect the hoppers. If the horses are in front of the middle of the pan, many of the hoppers will jump out at the sides and escape the pan. Every hopper that gets wet with the oil dies. Many will jump into the oil and jump out to die. When they become abundant in the pan, they should be thrown out.

Another type of hopper-dozer which is much liked by many who have used it catches the grasshoppers alive in a box. It is manufactured by a Mr. J. H. Behrens, Evans, Colorado, and costs about $12.00.

Grasshopper Diseases.—The African grasshopper fungus was experimented with quite extensively last summer in Colorado, nearly 400 tubes of the fungus being sent out to those requesting a quantity for trial. The station also used a number of tubes endeavoring to spread the disease among the grasshoppers about Fort Collins. There is very little evidence that the disease became destructive to the grasshoppers in any case where it was used. There is a native grasshopper disease that is generally distributed over the country which did kill great numbers of grasshoppers in nearly all parts of the state last year. It is a peculiarity of this disease that it causes its victims to crawl to the tops of plants to die. If his disease does not occur in a locality where grasshoppers are abundant, it might be well to obtain a quantity of the dead hoppers from this disease, crush them as finely as possible in water and sprikle the decoction over the living hoppers and food-plants where possible, especially upon low ground, and just before dark.

CARBON BISULFIDE, "FUMA"

BY C. P. GILLETTE.

This is a clear, extremely volatile liquid with a very disagreeable odor. The fumes are heavier than air, so that it is always best to expose the liquid in the upper part of a building, or other receptacle, containing objects to be treated. The fumes are explosive also when mixed with air, so that great care must be taken not to bring fire near them.

For the purpose of fumigating a building or other inclosed space containing growing plants, not over one pint of the liquid to 1,000 cubic feet of space should be used. For the destruction of insects in seeds, carpets or clothing it may be used much stronger.

To destroy ant hills, thrust a sharp stick down into the hill to a depth of eight or ten inches and then remove it and pour in two or three ounces of the carbon bisulfide; fill the hole with earth by stamping on it, and then throw over the hill a wet blanket to hold down the fumes. Allow the blanket to remain for a half hour at least, and the ants will be dead. If the hill is a very large one it would be well to make two or three holes for the carbon bisulfide.

To kill prairie dogs, pour three or four ounces of the liquid on a ball of cotton and roll the latter down the prairie dog hole and quickly fill the mouth of the hole with dirt.

THE POTATO FLEA BEETLE

(Epitrix Cucumeris.)

BY S. ARTHUR JOHNSON.

The injury caused by this beetle to the potato harvest consists in mines made by the larval form under the skin or into the flesh of the tuber. The insect at this stage appears like a tiny worm as large around as a pin and perhaps three-sixteenths of an inch in length. One may often see a portion of it protruding from the surface of a freshly dug potato. Its work is readily discovered by peeling a potato, when the discolored little holes will be quite conspicuous. These mines are most numerous near the surface, but may extend an inch or more into the flesh.

The worms now in the potatoes will develop into the adult, a minute black or dark brown beetle, which feeds upon the leaves of the potato and similar plants. When alarmed it has the power of jumping very quickly like a flea, whence its name. In patches where it is very numerous the leaves will often be found to be punctured with little round holes made while feeding. These may not be numerous enough to attract attention, however, even when the injury to the crop is considerable. The only sure way to discover the pest is to unearth hills in various parts of the field and examine the tubers carefully.

The potatoes are also injured in a manner resembling the above by the maggot of a fly which burrows under the skin producing a scabby appearance. The potato pulp about the burrow is brown and corky.

Efforts should be made at this time of year (September) to prevent, as far as possible, further injuries and to forestall the pest next year. To accomplish this the potatoes should be dug as soon as their ripening will permit and, if possible, exposed to the air and sunshine for at least a few hours, prefera-

bly a day, before picking from the ground. When there is danger from freezing it will be impossible to leave the crop out of doors over night.

This treatment will largely prevent further depredations by the insect, but in case the damage should be continued in the stored tubers, some method of fumigation must be resorted to.

Of these probably carbon bi-sulfide will be the most satisfactory.

Carbon bi-sulfide is a volatile inflammable liquid which may be obtained in quantities at about 10 cents per pound from Edward R. Taylor, Cleveland, Ohio. In the ordinary potato cellar about one-half pound to one pound will be necessary for each ten feet square of the floor surface.

To apply the fumigant the cellar must first be made very tight. Close the ventilators so that none of the fumes will escape. Make the door tight and prepare cloth or other material to pack around it when it is closed. Then shallow dishes or deep plates may be placed on the bins as high as is convenient. This is in order that the fumes, which are heavy, may settle down over the potatoes. When all is in readiness the dishes may be filled and the doors closed promptly and securely and left in this condition until the following day, when they may be opened and the fumes allowed to escape before anyone is permitted to enter.

It should never be forgotten for a moment that the fumes of carbon bi-sulfide are very explosive and poisonous. No fire of any kind should be allowed near the open can or in the building where the liquid is being evaporated. This caution applies to lighted pipes, cigars and lanterns.

The strong fumes when breathed for a short time produce unconsciousness which will result in death unless the sufferer is promptly supplied with fresh air. Bearing these things in mind, carbon bi-sulfide, in the hands of an intelligent person, is one of the most efficient fumigants with which we have to do.

The insects mentioned here will doubtless be most numer-

ous next year in fields where potatoes were raised this year, and it is very desirable that next year's crop be planted entirely upon other ground.

FUNGUS DISEASE OF THE POTATO

BY WENDELL PADDOCK.

Unfortunately the damage to the potato tuber does not stop with the insect injury. Various forms of fungi are abundant and ready to enter and extend any injury. It would not be surprising if the badly infected tubers would also rot badly. Early digging and exposure to the sun will not only kill most of the insects, but will be helpful in that some forms of fungi are also killed by exposure to the sun.

The necessity of handling green potatoes so as to avoid bruising, can not be too strongly emphasized. Bruised surfaces on potatoes, especially if they are sacked, or placed in piles while the injury is still moist, invite the entrance of the germs of decay.

To sum up; it will probably be best to dig all potatoes infested with this worm at once. Allow the tubers to lie on the ground at least three hours, a half a day will be better. Do not use a sorter. Handle carefully and spread out as thin as possible in the cellar.

TRANSPLANTING LARGE TREES

The transplanting of fruit trees in the middle of winter is a delicate work, but if successfully accomplished it pays well for the risk and labor. Often there are fruit trees on the farm which could be transplanted with profit to more favorable localities. There are trees which do not seem to thrive well, and it is often necessary to cut them down, and plant others in their places. It spoils the row of trees if a young sapling is planted in its place. It is often desirable in such instances to obtain a half-grown tree, and plant it in the place of the old one.

Probably there is no better time to transplant the tree than in the middle of winter. It is at such a time when little work is required on the farm, and when the sap of the tree is dormant. Select a time when the ground is thoroughly frozen, and do the work on a day when there is no danger of the roots being thawed out. Dig a large hole where the tree is to be planted, making it so large that a big ball of earth can be accommodated. The best way to judge of this is to make a circle around the base of the tree to be transplanted, running out even with the branches. Make a similar circle where the tree is to be planted, and dig a hole correspondingly large. Make it deep and soften the earth in the bottom, so that the soil can be packed close up to the roots of the tree.

The earth should be cut around the tree to the depth of several feet, but not closer to the base of the tree than the circle drawn. Where the tree has very spreading branches, the roots can be cut a little closer to the base, but generally where the limbs are branching the roots are likewise. If the roots are frozen solidly and the day is cold an enormous piece of solid earth will be dug up with the tree. Only the smaller roots will be cut off, while the main ones will not be disturbed in their

position. When the earth is dug away, if the tree is a large one a derrick will be required to lift it on a stout wagon. The ball of earth is heavier than the tree. It is very essential that this earth around the roots should not be disturbed or knocked loose.

With the same derrick the tree can be lowered into the hole made for it, and if the soil has been loosened sufficient at the bottom the dirt can be packed closely around the small ends of the cut roots. The soil should be packed thoroughly into the cavity, until the whole is thoroughly covered up. The tree is then firm and strong against the winds. It is better to put a mulch around the tree then for the rest of the winter, to keep the frost in the ground, or at least for a week after the transplanting. In this way a number of new, full-grown trees can be transplanted to the orchard and old dead ones removed. The trees will start to growing in the spring almost as if never disturbed.

HOW TO GROW POTATOES

Our farmers doubtless desire all the information they can obtain concerning the growth of spuds, so we reprint the following address, delivered to an assemblage of Greeley farmers by Mr. E. R. Bliss, one of the largest and most successful potato raisers in that district:

"We find that our seed raised under irrigation runs out very quickly—in two years and perhaps three with some, is the most that it can be planted with success. We assume it to be due to the potato running out, but whether it is forced by irrigation and the extra large growth so caused or whether our soil is diseased, we do no know. Most of our farmers lay it to irrigation, which may help on the disease, as it hardens the soil. At the low point where the ground gets thoroughly soaked there is danger of a scab, or the vines die.

"We use for seed medium sized potatoes, preferring for size one that will cut in four pieces in planting with the Aspinwall planter. We use smaller and get a better stand from small seed. We are not sure but the green potatoes picked before they are ripe make better seed than ripened potatoes; it is a question.

"Those same potatoes taken from near Greeley and planted above irrigation are nearly always smaller. They do not seem to do well taken from irrigated land. They have grown over ten thousand acres in the Greeley district, our best potato soil being the alfalfa breaking.

"Our potatoes are planted along the latter part of May and the first of June most all of the potatoes having been planted by the 3rd or 4th of June. Our alfalfa sod, standing two or three years—three years is better than two years—and cut hay from, is irrigated in the spring as soon as we get the water, usually coming into the ditches about the first of May, some-

times a little during April. We irrigate that ground and let it get nicely started—you know how quickly alfalfa will grow, coming with us an inch a day. As soon as it ranges from a foot to fifteen inches high we turn it under, turning under seven or eight inches—eight inches most everyone plows—turning the heavy green growth under. That rots very rapidly, so that the ground is in condition to plant by the 1st of June. That is our best ground for planting potatoes. We of course harrow, use both walking and riding plows, seldom do fall plowing. Preferring to get that green growth, we do nearly all our breaking in the spring. Our experience with fall plowing is that the ground gets very dry, so that it is hard to get it in shape. Harrow it down and pulverize it on top. It will dry down of course an inch, but the dust blanket holds your moisture underneath. We usually grow two crops of potatoes and get it back to alfalfa as quickly as we can, following it with wheat or some kind of grain. Some plant the alfalfa the first year while some wait until the second year. We get it back as soon as we can, so we have about one-third of our ground in potatoes all the time and six years' rotation, which gives the best result. It does not pay to crop it in potatoes longer."

It is said that the Greeley farmer sends to Wisconsin or New York for his seed potatoes, often paying fancy prices, considering it the only sensible and profitable thing to do. The success which has crowned the efforts of the Greeleyites in the spud line proves their good judgment in the selection of seed, but it is possible that seed could be procured much cheaper on the western slope of Colorado that would give satisfactory crops. In the Roaring Fork and Plateau valleys and portions of Grand valley itself, are grown large yields of most excellent potatoes, larger and better quality than the Greeley potato, which furnish a better grade of seed potatoes than are secured from northern sources.

CHEAP FARM PAINTS

It is often desirable to use some kind of paint to preserve wood and improve appearanees when the regular oil paints can not be afforded, and a list of these cheap paints to choose from is very convenient.

Perhaps it is well to head the list with "Government Whitewash," which, although not properly a paint, is used for the same purposes. It is used by the government to whitewash lighthouses and the directions for making it are as follows:

Slake one-half bushel of lime in boiling water, covering the barrel with something to keep in the steam during the slaking process.

Strain the liquid through a fine sieve and add to it a peck of salt dissolved in warm water, three pounds of ground rice boiled to a thin paste and stirred in while hot, one-half pound of Spanish whiting and one pound of clean glue previously dissolved by soaking in cold water and then heating slowly in a double boiler. Add five gallons hot water to the mixture, stir well and let stand a few days, covered from dirt. This must be applied hot. A pint of this whitewash properly applied will cover one square yard and is very serviceable. It can be used on wood, brick or stone. If a color is desired add yellow ocher for cream, lamp or ivory black for pearl or lead. For fawn add proportionately four pounds of umber to one pound of Indian red and one pound of lamp black. For stone color proportionately four pounds raw umber to two pounds lamp-black. Venetian red, indigo, Spanish brown, etc., are also used for coloring. Green must not be used with the lime, as the mixture injures both the color and the wash.

Another whitewash that is claimed to be good for outside work is made by adding to each gallon of ordinary whitewash a

tablespoonful of alum, a half pound of flour paste and a half pound of glue. The writer has not tried this, but gives it on another's recommendation for those who do not wish to try the first recipe.

A red paint that is recommended for out buildings is made as follows: Take skim-milk that has just begun to thicken. Add to one gallon of milk three pints of good, coarse salt and iron brown or Venetian red in the powder form to make the color desired. Keep the mixture well stirred all the time and put it on the buildings when there is no danger of rain. After it is once dry it will not wash off.

Another paint is made by adding sweeet skim-milk to hydraulic cement until the mixture is of the consistency of thin cream. Stir very thoroughly so that the mixture will flow readily from the brush. If too thin the paint will streak. The proportion is about one quart of cement to a gallon of milk. Mix only this quantity at a time, as it hardens before it is applied if too much is prepared. This is a good paint for wood, brick or stone. It is a yellowish stone color.

HOME-MADE VINEGAR

If it is impossible to get vinegar from a farmer or some other person who makes it for sale, there are a number of simple ways of making it at home. I have found it very little trouble, it costs nothing, and you know what you are using. Half gallon fruit jars are better than stone jugs to make it in, as a larger surface is exposed to the light and air, and by shaking often oxygenation, souring is hastened. A cloth should of course be tied over the top to keep out insects and dust. The jars should be set in the sun and whenever the fluid has worked clear strain off and leave it in a warm place until it is sharp as desired. When mother forms, new vinegar can be made by simply adding sweetened water. Always use soft water, but if it is not available boil the water and set it in the sun a day or two.

The following are some excellent recipes that can be adapted to different localities and seasons:

Vinegar from Apple or Peach Parings.—Fill a jar half full of parings, add one-half teacup of molasses and fill up with water; set in the sun and strain for use in about two weeks.

Corn Vinegar.—Put one teacup shelled corn and one teacup brown sugar or molasses in a jar. Fill up with water and set in the sun. This takes three weeks to make, but is one of the very best vinegars.

Tomato Vinegar.—Mash one quart of ripe tomatoes to a pulp. Strain the juice and put in a jar with one teacupful sugar or molasses. Fill the jar with soft water and set in the sun for two weeks.

Yeast Vinegar.—Dissolve a half teacupful brown sugar in one pint warm water and add a small yeast cake. Fill the jar with water. This will be ready for use in two weeks.

Alcohol Vinegar.—This is the least desirable of any for home use. It is made by using one part alcohol to four parts water. It is fermented with yeast as in the foregoing recipe or by the German process of filtering through beech shavings, but this is a laborious undertaking and not adapted to domestic purposes.

Blackberry or Raspberry Vinegar.—Cover one quart berries with strong vinegar. Let stand two weeks. Then mash the berries and strain the whole over one quart fresh berries. Let stand a week, then mash and strain again. To each quart of vinegar add one pound sugar, bring to the boiling point, skim and bottle while hot, using sound new corks. This furnishes a grateful acid on hot days, diluted with water and poured over cracked ice. It also makes a refreshing beverage for the sick.

PRUNING THE APPLE

BY FRANK CROWLEY.

The first thing to do is to arm yourself with a good, sharp pruning knife. If pruning is done at the proper time and in the proper manner no other tools will be necessary, but if neglected, or too many main branches are allowed to grow, the saw will have to be used. In cutting off a branch the knife should follow the shoulder, which we notice at the junction of the branch to another, or to the main stem, and the surface of the cut should be no larger than the base of the branch removed. To make a cut of this kind, the knife must be drawn inward a little, care being taken not to cut the bark on the main stem. We often see a limb cut off with an outward stroke of the knife, leaving a sharp stub at the upper side of the cut which will require a year or two for the bark to grow over, or from which a new shoot may start. On the other hand, we frequently see the cut made too close to the main stem, causing a very large wound or peeling the bark from the top of the cut, or up the tree some distance. Either of these should be avoided. In removing a portion of a branch the proper way is to take the branch to be operated on in the left hand, below the place where the cut is to be made; place the edge of the knife on it directly opposite the base of the bud to be cut to, and then make a firm, quick, smooth draw-cut, sloping upwards so that the knife will come out on a level with the point of the bud. If we cut too close to the bud, so as to remove some of the wood with which it is connected, the bud will die, or else make a very feeble growth, and the bud below it will take the lead. While if we cut too high the wood will die down to the bud and make an unsightly stub if not cut off in after pruning.

Where the saw is used in cutting a heavy limb, first saw a little at the lowest part so that when you saw through from the top the weight of the branch will not peel or split off some of the bark from the main stem as it falls. Saw cuts should be trimmed smooth with the knife to make them heal more quickly. It is also a good plan to paint large cuts to prevent the wood from drying and cracking into the tree too much.

In growing an orchard by irrigation we do not have to prune in summer to produce fruit, not to prune in winter to encourage growth of wood, as they do in the East. This we can see by the orchards already in bearing, that trees grow more rapidly, and that the same varieties will commence bearing in from one-half to two-thirds the time required in eastern localities. This, I think, is mostly due to the fact that if the soil is kept uniformly moist the roots do not need to go so far nor so deep to obtain the food required and are settled down to business in less time. I think the best time to prune is just after the sap starts in the spring, in May or the fore part of June, as the wound will heal sooner and better at this time than at any other. If it is impossible to get at it at this time I believe I would prefer February or March.

To give a tree the proper shape, pruning must be practiced from the time it is set in the nursery row through all the processes of culture until it has passed beyond all usefulness. But until it leaves the nursery and is given a place in the permanent plantation about all the pruning that is necessary is to keep all the suckers and limbs rubbed or cut off that come out below the place where the main head should start. Before being set in the ground any roots that have been bruised in the digging should be trimmed. After setting, the ground should be allowed to settle around the tree so that the knife can be used without loosening roots or having to hold it in the ground with one hand while you prune with the other. When you attack the tree cut off all the limbs on the main stem, if any remain, up to where you want

to head the tree. I believe the majority of fruit growers in the West recommend a low-headed tree, say from twenty inches to three feet, and I think there are few who would choose a tree headed five or six feet from the ground. The only advantage of high-headed trees is that they are more easy to get around with a plow or other implements. A high-headed tree exposes more of the trunk to the hot rays of the sun, and will get too top-heavy to cope with the heavy winds which sometimes prevail. It also requires more time to get a tree up to that height and form a good, substantial head than with lower-headed trees.

From what experience I have had in growing young trees in the nursery and pruning them when set in the orchard, I consider that the exact height of the head should be governed by the particular tree in hand, and the branches chosen that are good and thrifty, and well set and well balanced. Be very particular to avoid leaving any forks in forming the foundation for the head of the tree, as these will split if too heavily loaded with fruit. But if impossible to balance the tree without leaving a forked branch, it can be made strong by taking two cross-limbs, one from each side of the fork, and twisting them together where they will grow fast and form a good brace; two or three pairs of these could be fixed up along the branch and make it quite secure. If three limbs come out so as to balance well, they will be better than four for the first main branches. The leader, which should always be strong and in advance of others, should be clear of limbs for at least a foot above the first set of branches, when there should be another set, balancing like the first, and so on up as the tree grows, always bearing in mind that a limb never gets any farther from the ground at the base than it was when started, and that when the main branches get to measure several inches in diameter, they will crowd, if left only two inches apart along the stem, so that some will have to be removed, or the tree will be spoiled. Next, do not cut back the limbs, as is practiced in the East, and has been done a good deal in this country. In the East

it is done to make the tree branch more; but they branch entirely too much here, so if this system is practiced all the buds along the limb that would have made fruit spurs, or remained dormant, are forced and make a lot of cross-limbs that have to be cut out the next season; so we lose not only all that growth, but that which we cut in the first place besides spoiling the shape of our tree by making a crook wherever we cut a limb back.

A mistake which I have noticed several making, is to cut off the little bushy-looking spurs which grow along the main branches near the trunk, with a view of preventing cross-limbs in the center of the tree. In doing this you deprive the body and larger limbs of much protection from the sun, and at the same time destroy a great number of fruit spurs which will bear a year younger than most of those higher up on the limbs. Of course some of these would become water suckers if left; but it is plenty of time to cut them off when they have developed into such.

THE TREES OF DENVER

W. G. M. STONE, DENVER, COLORADO.

The purpose of these papers on "The trees of Denver" is to collect and put on record, for future reference, data relating to the progress our people are making in tree planting.

The same as a year ago, this discussion will be confined to deciduous trees not indigenous to Colorado. The only deciduous trees native to Colorado, found suitable for shade, were the cottonwood and box elder; but these are not satisfactory, and our citizens have ceased planting them. To supply their place they have been bringing trees of better grade from beyond the plains.

The number of varieties thus introduced, as given last year, was fifty-three; but that list should be modified and increased. During the past summer quite a number of additional varieties have been observed, thus increasing it to sixty-six, as follows:

Soft Maple.
Sugar Maple.
Norway Maple.
Cut Leaf Maple.
Sycamore Maple.*
Japan Maple.**
American Elm (three varieties).
Huntington Elm.
Red Elm.
Scotch Elm.*
Cork Elm.
Weeping Elm.
White Ash.
Balm of Gilead.
Weeping Mountain Ash.
Black Locust.
Honey Locust (thorny.)
Honey Locust (thornless.)
Clammy Locust.
Hardy Catalpa.
Tender Catalpa.
American Linden.
European Linden.*
Carolina Poplar.
Lombardy Poplar.
Silver Leaf Poplar.
Siberian Poplar.
Basket Willow.

White Birch.
Black Birch.
Pyramidal Birch.
Canoe Birch.*
Weeping Birch.
White Oak.
Red Oak.
Burr Oak.
Swamp Oak.*
American Weeping Willow.
European Weeping Willow.
Laurel Leaf Willow.
Green Ash.
Blue Ash.*
European Ash.*
Weeping Ash.**
Mountain Ash.
Oak Leaf Mountain Ash.
White Mulberry.
Red Mulberry.
Russian Mulberry.
Horse Chestnut.
Buckeye.*
Black Walnut.
Butternut.*
Chestnut.**
Hawthorn.*
Sycamore.
Hackberry.
Wild Cherry.
Coffeynut.
Russian Olive.
Tree of Heaven.
Red Bud.*
Persimmon.*
Cucumber Tree.*

Of the foregoing there are thirteen that, so far as I have observed, have but one representative; these are marked with one star; those having only two are marked with two stars.

To one familiar with forests of the East it will be apparent that but few varieties remain without representation in Denver.

Several of the new trees noticed during the year deserve some special mention. The Sycamore, Maple and Japan Maple enumerated may be seen in Fairmount cemetery.

On the lawn of ex-Governor Grant is a pretty little tree bearing large, beautiful leaves. I have listed it as the Cucumber tree, believing it to belong to that branch of the magnolia family.

The only Buckeye observed may be seen at the residence of William Davis, at the corner of Clay street and Thirty-second avenue, on the "North Side." This particular tree has endured many hardships, proving it especially desirable in this climate,

and it is singular that the Ohio Buckeye should not be better represented.

One of the most puzzling trees met in my rambles stands at the corner of Stout and Twentieth streets, in the north corner of the High school lawn. Its girth is twenty-one inches. It is doubtless a member of the Ash family, but is not of the blue, white, green nor black varieties. To give it a place I have called it European Ash.

A tree quite unique in character and local history is at the corner of Clay street and Thirty-ninth avenue, Highlands. It was set by Mr. Perrin, well known among the "old-timers," and twenty years ago was about seven inches in diameter. Its present girth is seventy-five inches. This tree has the peculiarity of holding its leaves fresh and green through the early frosts. The wood is tough and flexible, and when bent by snow recovers as soon as liberated. This tree is known as the Cork Elm; it is more symmetrical and more attractive than the Huntington Elm; better limbed, with finer, richer foliage. About twenty years ago the owner, Mr. Douglas Washburn, was offered $100 by H. A. W. Tabor, and by other parties a larger sum, which offers were refused. A few of our trees deserve more attention by our people. Several varieties are far too scarce. One of these is the Hard Maple, a tree scarcely second to the American Elm. Valuable and beautiful as it is, there are comparatively few in Denver; and of these few it is important to note that a large per cent. is of the Norway species. This fact I have observed during the past summer. The Norway Maple and the American Sugar Maple so much resemble each other in almost every particular that it is difficult to distinguish between them. If, after the trees are in leaf, a bud be taken from the tip of a twig of the Norway and broken it will exude milk; the American Sugar Maple will not. Of these trees there ought to be hundreds instead of dozens.

Just a word about the Catalpa. During the year this tree has received considerable attention in order to ascertain whether

we have the hardy or tender variety, or both. By observing the blooming time it was found that some bloom early, others about a fortnight later, and the seeds confirm the fact that all our Catalpa are not the speciosa, which, in part at least, will account for winter killing spoken of a year ago. The early bloomers belong to the hardy variety. Another tree, of which we have too few, is the Black Walnut. It is sometimes asked if we have any. A few good specimens may be pointed out. At 1507 Grant avenue is one with a girth of twenty-three inches; two at 1525 Sherman, twenty-one and one-half and thirty-three inches. On the lawn of Mr. C. B. Kountze are three measuring twenty-five, twenty-eight and thirty-five inches. Of course, there are others, scattered over the city, but these are the largest I have seen. No tree in Denver seems healthier or more at home than the Black Walnut.

The Linden, too, is not as much appreciated as it should be. It is too often regarded as a common sort of tree. In Europe it is a favorite. The finest avenue in Berlin is set with it and called "The Linden." The largest specimen observed is at 1300 South Fourteenth street, having a girth of thirty-five inches, while another at 200 West Colfax measures thirty-one inches. It is healthy, grows rapidly and is a desirable tree for both street and lawn. It is a matter of surprise that the Horse Chestnut has received so little attention. There are very few in the city, yet when in bloom it is one of the most beautiful trees in America, second only to the Magnolia. At Bushy Park, a few miles southwest of London, is a celebrated triple avenue, more than a mile in length, lined with Horse Chestnut, set by William III. about 230 years ago, and when in bloom the people of London flock to see one of the most delightful sights of the kind in the world. The largest one observed is at 1601 Sherman avenue, of twenty-six inches girth; another at 1525 Sherman measures twenty-two and one-half inches.

Among other trees entitled to more attention may be named

the Thornless Honey Locust, Russian Olive, Chestnut and Butternut, all of which appear healthy and hardy, and promise good results if given a sufficient trial. While there is much to be said in this line, yet there are some features of the tree problem undiscussed which I desire to touch upon.

Whatever trees are found to grow successfully in Denver would thrive at all other points in the state adapted to deciduous tree culture. Therefore, the forestry experiment station for Colorado, to a degree, is important. We are determining what trees are to be used in the future for shade, for ornament and for economic purposes. Every citizen, therefore, whether for himself or as the representative of any public board or commission, who plants a tree and gives it care, becomes a factor in this experiment work in forestry, for the benefit of the future. During the thirty years now past our people have expended money enough in deciduous trees from beyond the plains to constitute many a princely fortune. These trees have been brought by hundreds of thousands and planted in a strange land. They have been placed in high altitudes, in adverse conditions of aridity of both soil and atmosphere, and in peculiar extremes of diurnal temperature. In their native home they had an even temperature between day and night, but here all conditions are new and in many respects adverse.

Now, in view of these facts, are we to presume that, of the sixty-six or more varieties already transferred to these strange environments, all will succeed? Is it not reasonable to expect that some may fail? It is too soon, of course, to form fixed opinions. Trees are long lived, and it will take many years to demonstrate what results this climate will effect, to know what trees will ultimately succeed and what will not. Nature is very indulgent; she adapts and adjusts and may do wonders to acclimatize. On the whole, so far, the experiments have been sufficiently encouraging to confirm the hope of ultimate success as to most of the more desirable varieties. A few failures have occurred

and some others may follow. A few years ago Hon. William N. Byers set some Hickory that failed; also several Pyramid Oaks which are also failing. I note some of the Mountain Ash are dying; of what I do not know. The only Blue Ash noticed is dying of the borers. The White Ash and Green Ash also are failing from the same cause. Five years ago there was no tree more promising to Colorado than the White Ash, and only two trees of the whole sixty-six varieties had more friends. Two years ago last spring where could have been found four rows of brighter, healthier looking trees than adorned the east and west lines of the capitol grounds? On account of borers they are condemned and must be removed. The loss of the White Ash is a severe blow, and one we shall feel more and more as the years go by. There are a few other omens of evil, though far less alarming. The Elm is also found in some parts of the country and is doing some damage also to our Denver Elms. The Elm is also suffering from the Elm cluster louse. The Soft Maple and Black Locust have a mischievous leaf pest, causing their leaves to turn yellow and begin falling in midsummer. During the past season, late in August, I noticed the leaves of two or three Norway Maples with the borders faded out, as if they had been scalded. Further than this I have noted no trouble with our trees. Most of them are healthy and vigorous and promise excellent results. These diseases, however, are not confined to Colorado. Most, if not all, of them may be met with in states east of the plains; hence we can scarcely charge them altogether to climatic influence.

Before closing, there are two or three evils of another class which I desire to mention. In a way they are as detrimental as disease. One is the mistake some make of setting trees too large. People want shade quick and often plant trees from five to twelve inches in diameter. On many beautiful lawns such trees can be seen—trees with ill-shapen tops, also with bad defects in the bodies; these trees can never be beautiful. A large tree

taken up with most of its roots left in the ground and the remainder unmercifully lacerated, with the top nearly all cut away (necessarily) and transplanted, however well set and cared for, can never make a perfect tree. Its perfection and beauty can never be recovered. A young, thrifty tree, of two inches caliper, or even less, will be worth more in ten years than any one of the foregoing at any age. As a tree is not for to-morrow alone, the mistake of setting them so large ought not to be made.

Another evil is the lack of pruning. On all our streets are ragged, ill-shapen, ill-balanced, unsightly trees. They have become so for want of proper pruning; and at the same time there are other trees just as unsightly because of too much trimming. There are hundreds of trees about the city ruined, hopelessly ruined, by ignorant, reckless pruning. Trees should be pruned, but not butchered. They should be pruned by an intelligent forester, one who has been educated in the school of forestry, such as they have in Germany and such as are being started in this country. A forester is to trees what a physician is to the people. An ignorant pruner is to a tree what a quack is to a patient.

All in all, considering the many and great disadvantages our people have been compelled to work against, they have accomplished wonders. They have brought nearly every kind of tree from the forests of the East, at great expense, and are demonstrating their adaptability to our state, and by another generation the trees of Denver will be a glory to the city and a guide to the arboreal and forestry needs of the future.

FARM DRAINAGE

BY E. S. ALLEN, LOVELAND, COLORADO.

There are yet living in this community a goodly number of the "old-timers," those who came to Colorado in the early 60's and located upon some of Uncle Sam's broad acres on the Big Thompson river, as ranches, for in those days farming in Colorado was unknown, at least but little had been done in that line to demonstrate the possibilities of the soil for crops, except native hay and the abode of the settler was known as a "ranche" rather than a farm, a place for the raising of horses and cattle, which in reality was the principle occupation of the early settler in the valleys, and the bottom lands were sought by the locator as the land best suited for ranching purposes, the bluff or up-lands being considered fit only for grazing purposes, and was the grand domain of the herds.

Irrigation in those days was certainly in its infancy, and as yet, with forty years of experience in the application of water to crops, we have something to learn, both as how best to apply, and to conserve our waters.

Conditions are materially different now as compared with those early days when the agriculturist had at his command all the water he desired, and as the crops were largely the native hay, and these crops upon bottom lands, they were not stinted for water, in fact flooding for weeks at a time, without injury either to crop or land, was the common practice, and we are told that the Big Thompson river was often out of its banks, even from "bluff to bluff," inundating the whole farming community as it then existed, yet causing none of the conditions now so prevalent in almost every glade, draw and bottom lands, that of alkali.

Drainage was unthought of in those days, or even a ditch to carry off surplus water, for with the subsiding of the "flood" the water soon left the soil and was gone.

It may seem strange to one unfamiliar with conditions as they then existed, that the application of so much water, either naturally or by artificial means, did little or no damage to the land, while in these latter days so much of our land is ruined by seepage and alkali, and the application of water in measured quantity, a necessity, if we would preserve the farm from utter ruin.

The reason for this is obvious, when we study the conditions:

First—The waters of the river were comparatively pure, at least free from alkali salts now so common in almost all irrigation water, and,

Secondly—The river floods, if covering to any considerable extent the farming lands, remained but for a short time, the bottom lands being loose sandy soil, the surplus water soon drained off or sank away, improving if anything the soil by the deposit of such fertilizing properties as water under these conditions usually carry.

But the irrigation of the bluff or uplands, brought about another condition.

The soil of our valleys for a considerable depth, are formed from the drifts and washings from the sand and shale rock of the adjacent mountains, carried out upon the plains during the ages past, and these soils contain a large quantity of mineral, to us commonly known as mineral salts, or alkali.

These mineral salts are a potent factor in making our western or arid lands so productive, and it is this that largely assists in keeping up the fertility of the soil, giving us year after year so uniform return, while our eastern brother must replenish the soil annually with fertilizers if he would preserve their productiveness. So we may say in reality, that the so-called alkali is to

the western farmer, a blessing, rather than an evil, provided it is properly applied, or rather regulated and controlled.

The annual rainfall of the arid country being so very small, these mineral salts had gradually worked down into the soil, until irrigation became a part of the method of farming, without materially affecting vegetation, and the bottom lands were periodically freed to a large extent of these salts, if any they contained by reason of the flooding and leaching, as the water receded or sank into the earth.

But this condition does not exist upon the bluff or uplands, under the system of irrigation.

These lands are underlaid with a clay soil, very difficult for water to penetrate. The application of water to the fallow land, dissolves large quantities of these alkali salts, which for the most part are carried along the clay subsoil in solution to the lower levels, where we find the water making its way to the surface in almost every draw or gulch, in excessive quantities, carrying with it the salts or alkali, the water upon reaching the flats or bottoms being subjected to evaporation the alkali through filteration, to deposit upon the surface of the land, destroying vegetation and rendering the land unproductive.

The formation of these alkali flats in the accumulation of alkali salts, upon the surface, is an evidence of the effect of nature to correct the faults of our crude system of irrigation. The salts are being carried off in the natural drainage of the country, but the process is very slow, too slow to affect any good result. The excess of seepage water and the salts themselves collect in these places on account of the inability of the soil to let them pass as rapidly as the excess of water is supplied. This suggests the necessity of artificial aid to assist in carrying off both water and alkali, fully as fast as the source of accumulation.

Perhaps I have digressed from the subject assigned me, that of "Farm Drainage," but I deemed a cursory reference to the causes that have brought about a necessity for drainage not out

of place, as we may as well meet the conditions as they exist, and charge this necessity in a large part to the peculiar features of our country, and perhaps to an excessive use of water.

We realize that under our system of irrigation, the whole country below the ditches, is charged with water, contrary to the conditions existing before the settlement of the state. That the water dissolves a vast amount of mineral salts, and in its outward movement to the lower levels carries with it in strong solution these salts or alkali, and whereever the water finds the surface, vegetation is destroyed, and the soil rendered unfit for agricultural purposes.

But while seemingly destroyed, much of the land may be reclaimed by drainage.

We have said that the so-called alkali is the strength of the soil, and rightly so, in limited quantity. The irrigation of our farms with water from lakes, containing as they do a large quantity of alkali, when properly applied to crops, do not produce injury to land or crops, because with natural drainage the water sinks into the soil, with proper application, as fast as supplied, taking with it the greater part of the salts or alkali, a limited quantity being retained by the soil, a fertilizer productive of good.

But you may ask, "why the conditions as found upon some of our bottom lands to-day, where water has not been applied for many years, yet the surface of the soil is white with alkali." The answer must be, that water from some source is continually seeping from the higher lands in and upon these flats, the natural drainage defective, because of insufficient fall, the land soggy from long continued moisture, and the alkali is "strained out" into the soil rather than being carried away with the water and the action of the sun evaporates the water near the surface leaving the alkali deposit.

In such cases, the artificial drain is needed to assist in drawing the water, and with it the alkali, downward through the soil

into a drain, that will carry the water faster than the natural flow, or faster than it accumulates in the soil. In this way the greater part of the alkali is taken from the soil and as has been demonstrated in many instances, and the land reclaimed. A drain for this purpose in my judgment should be an underground or covered drain.

We have seen attempts to drain land by the construction of ditches mostly the open ditch, that have proven of little or no value for the purposes intended, and I am not prepared tt say that in all cases land may be drained and reclaimed or at least without great expense, but the greater part of all of our side-hill lands, and those having considerable fall, may be reclaimed by properly constructed drains, and at reasonable expense.

This brings up another important feature of the drainage question. That of cost. And will it pay. These are questions largely to be determined by the conditions in each particular case. There are some lands that may be drained by the construction of a single line of drain, others will require two or three, while some lands will require a net-work of drains, to successfully meet the conditions, that is, one main line, with laterals leading out in different directions as the "lay of the land" may require, and at stated distances apart, in order to thoroughly relieve the land of excess water as fast as it accumulates, and such system would to a large extent be controled by the character of the out-let, grade, etc., it being borne in mind that the main drain and the laterals as well, should be of sufficient size to never be entirely filled with water for if forced to run full, much of the drainage effect is destroyed, and the land will not properly exhaust itself of water.

The cost of these drains will vary of course with the character or kind of materials used, and number required. I have known land to be fairly well drained with a simple wooden box, and in many instances where the grade is heavy, such kinds of drains may be used with success, but it requires more care to put

in this kind upon an even and regular grade than some others, as they fill up more readily than tile, and of course are not as lasting. The tiling in my judgment is far preferable. The water will follow this character of material much better, find an inlet at every joint, of about two feet, is not so liable to fill up, and lasts when once put in.

Another phase of the drainage question, is that of the "Out-let." We recognize that there are many places requiring drainage, where it will be difficult to obtain an out-let to the river, or other natural drain-way, with sufficient fall for a successful system of drainage, on account of the distance to reach a drain-way, or the passing through the lands of adjacent farmers which necessitates the acquiring of right-of-way and other expenses. But many large tracts of land may be drained by farmers joining in the construction of a main drain to a common out-let, and each connecting thereto at points most advantageous thus relieving the lands of its excess water, and this water may be put to beneficial use further down the line, thus in a measure compensating for the outlay.

I have had but little practical experience in the line of "drainage" and this experience has not been carried to its fullest practical extent because the system commenced has not been completed, but as far as we have gone it has proven satisfactory.

On our farm, there existed a number of years since, a "swale" covering several acres, which had never on account of its wet, boggy, condition, been under plow. It was an eye-sore on the place, the dumping ground for all refuse of the farm, and of no productive value.

We looked up an outlet for a drain, put in a wooden box made of 2x6's a three-sided box, open side down, extended this drain some twenty rods across the field to the bottom lands and river, drew off the excess water from the "swale," plowed the land in the spring with the rest of the farm and cropped it. The result was, but little difference in the condition of the crop

from other parts of the field, except that it contained weeds in greater amount than the general crop.

Another feature of the crop was the remarkable growth of the grain the entire length of the drain, and the exceptionally large heads of grain, showing to my mind, that the loose soil of the drain-ditch for so great a depth and the irrigation with perfect drainage, removing the greater part of the alkali salts as this system does, it is just what our wet lands need. This drain was constructed through the lowest part of the "swale" and I may say it was not entirely sufficient, as water came into this land near the surface at the upper side of the "swale, and a lateral was needed to take care of the water in that direction.

But this system lasted for but a few years, and the land commenced going back to its former condition, and we found upon examination that the drain had not been properly laid, was uneven, sags and high places, the low places filled up, and water standing above the drain box and the box rotten and broken in.

This system was taken up and sewer pipe put in its place, care being taken to put the same on an even grade, and this, so far as completed has proven satisfactory.

There is no definite rule as to how the drain should be located in wet lands, to secure best results, "the-lay-of-the-land." and the grade, will largely determine the system required. If a sag or draw, it will require one kind, if a side hill another, and the flat or bottom land still another, and the "in-flow" of water in any of these cases will govern somewhat as to the requirements. A line of drain through the lowest part of a draw, where the water enters or makes its appearance at the head of the draw, with a "Y" at the upper end to catch all water that comes into it, will suffice to control this case, while the side hill, where water seeps out for a long distance, would require a drain near and along the entire portion of land where the water makes its appearance, placed on good grade, and conducted, per-

haps by several laterals to lower levels, the flat or bottom land, which is probably the most difficult to contend with, because sometimes the water does not come into this land until it has reached the bottom, having followed some shale rock or hardpan, until the land is reached, when it seeps up from the bottom, and the grade being slow, the alkali has for a long time been accumulating, "puddling" the soil until the natural drainage has been almost entirely cut off, and this character of land will require, no doubt, a net work of drains placed upon the best grade obtainable to affect desired results.

In any of the systems mentioned, it has been my observation that it is well to "cut off" as much as possible, rather than to "go with" the water. That is, where the water has a tendency to flow through a considerable width of ground, to put in a cross drain, conduct the water to a central line, and it may require this in several places, rather than construct the drains in the direction the water is flowing; in this way the water reaches the drain "broadside," naturally falls into it, and with reasonable grade, proceeds faster than it naturally was doing.

These drains (cross-cut) should be placed at a good depth, to prevent water from passing below, to any considerable extent, and rising again in the soil before it has passed out of the land desired to be drained.

While, as a rule, these bottom lands are loose and sandy, and should permit of water passing through them readily, the trouble has been lack of sufficient natural grade to conduct the water out of the soil as fast as it has come in. While it may have been sufficient at first, as the soil became charged with the alkali salts, slowly settling into the ground, it has become "puddled" until but little water passes through it and none of the alkali and it remains saturated with water and alkali.

I am aware that one of the difficult problems after the land has been drained is to get the land back into its former state

of productiveness, as in many instances the soil is so full of alkali salts that nothing will grow.

Some experiments looking to this end have been made with fair success by flooding the land after deep plowing, with water, the drainage being good, the water dissolves the alkali and carries it through the soil and out through the drains, "washing it out," so to speak; then as soon as sufficiently drained or dry, to plow and crop, and sparingly irrigate. That is, not allow the water to "stand" upon the land.

I have known instances where "wells" have been put in at stated distances, along the line of drain, that the surplus or overflow of water might immediately be run off into the wells and the drains, thus relieving the land of the excess amount that otherwise would of necessity be compelled to leech through the soil; this character of land, more than others, should never be required to "lay in water" after it is wet.

Difficult as may seem the conditions to reclaim, I am firmly of the opinion that with a good system of drainage, the careful and economic use of water, the greater part of our seeped lands may be brought back to productiveness, removing the unsightly appearance of many of our farms, rendering them more profitable, of greater value upon the market, at least from general appearance, and making us careful because of past experiences, in using no more water upon the farm than is actually necessary, thus accomplishing a double purpose, that of reclamation and conserving the valuable water.

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